FEBRUARY, 1939.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

470. Nuclear Physics at the Kaiser Wilhelm Institute for Medical Research, Heidelberg. W. Bothe. *Zeits. f. techn. Physik*, 19. 12. *pp.* 565–569, 1938.—Review of the work of Gailer on the (n-α) resonance levels in Ne; of Saha on the disintegration of F by α-particles; of Fleischmann on the Cd radiation produced by slow neutrons; of Norling on coincidence measurements of β- and γ-rays from radio-As, and of Bothe and Gentner on the nuclear photoelectric effect giving rise to $B^{11}(p, \gamma)$. F. C. C.

471. Thermodynamical Concepts in Nuclear Physics. U. Fano. *N. Cimento*, 15. *pp.* 343–364, *May*, 1938.—The application of thermodynamic methods to the study of heavy nuclei is critically reviewed. The author arrives at the conclusion that, although psychologically the use of thermodynamical analogies was a great help, the actual results that have so far been obtained with this method could be obtained quite simply without using such methods at all. R. P.

472. Recombination of Atomic Nuclei. L. Goldstein. *Comptes Rendus*, 207. *pp.* 965–967, *Nov.* 21, 1938.—An expression is derived which gives the order of magnitude of the probability that a projectile nucleus and a target nucleus will combine, with subsequent formation of a new nucleus by the evaporation of a heavy particle. The original two nuclei are assumed to approach and together to form a nuclear gas in a thermodynamically unstable state. The average life of the unstable state is then determined using the notions of viscosity and thermal conductivity of the nuclear gas. The desired probability is shown to be essentially determined by the average life. Theory and experiment are compared for the case of nuclear transmutation by fast neutrons. W. S. S.

473. Passage and Diffusion of Particles across Coulomb Potential Barriers. G. Badarau. *Comptes Rendus*, 207. *pp.* 1030–1032, *Nov.* 28, 1938.—The penetration coefficient was previously deduced for the special case of particles of zero kinetic moment [see Abstract 5 (1939)]. A general solution of this problem is now given. N. M. B.

474. Binding Energy of O^{16}. W. J. Kroeger. *Phys. Rev.* 54. *pp.* 1048–1053, *Dec.* 15, 1938.—A perturbation calculation has been made to determine the binding energy of the O^{16} nucleus. Zero-order eigenfunctions constructed from harmonic oscillator functions in a central field were used in conjunction with a symmetrical form of the Hamiltonian involving space exchange, space-spin exchange, non-exchange and spin exchange terms and only one range function of Gaussian form. The coefficients of the interactions were selected to give agreement with the scattering results and the observed energies of H^2 and He^4, and to satisfy the requirement of the upper limit of nuclear masses. The interaction so selected leads to a very small first-order binding energy, 19 mc^2. Second-order contributions to the energy were calculated from the interaction of excited states with the ground state. The energy is thus estimated to be about 79 mc^2 in second order. The third-order contributions were found to be disturbingly large, amounting to perhaps half of the second-order contributions, but of opposite sign. The procedure does, however, appear to converge and it is believed that the end result is indicated sufficiently well to show that the assumed interactions are inadequate to produce the required binding energy of O^{16}. AUTHOR.

475. Nuclear Two-Body Variational Problem. W. Rarita and Z. I. Slawsky. *Phys. Rev.* 54. *pp.* 1053–1054, *Dec.* 15, 1938.—To test the reliability of variational calculations in nuclear problems the energy and wave function for the ground state of H^2 is first computed variationally and then compared to the results obtained from the exact solution. For an exponential potential and for a wave function in the form of an exponential times a power series, it is found that the variational method is accurate and rapidly convergent. [See Abstract 2872 (1937).] AUTHORS.

476. Spacing of Energy Levels in Light Nuclei. L. Motz and E. Feenberg. *Phys. Rev.* 54. *pp.* 1055–1059, *Dec.* 15, 1938.—The single particle model supplemented by a semi-empirical determination of the dependence of potential energy on symmetry character is used to obtain statistical information about the distribution of energy levels in light nuclei ($A \leq 16$). A table shows the analysis of the low-lying configurations for $A = 16$ into states with definite values of the orbital angular momentum and the symmetry character. Similar tables were prepared for values of $A < 16$. Tables give the spin multiplet structure as a function of the symmetry type and the isotopic number $|N - Z|$. Finally the dependence of the level spacing on total angular momentum and on $|N - Z|$ in the several isobaric series with $A = 10, 11, 12$, and 13 is shown in further tables. The most frequently occurring value of the orbital angular momentum is $L = 2$ (D states). Levels with total angular momentum $F = 2$ (even nuclei) and $F = 5/2$ (odd nuclei) are most closely spaced. The level spacing is not a monotonic decreasing function of A; for example, in the series $A = 4n$ and $|N - Z| = 0$, Be^8 has 87 levels, C^{12} 192 and O^{16} has 60 in the energy range 0–23 eMV. In the series $A = 4n$ the level density is considerably greater for $|N - Z| = 2$ than for $|N - Z| = 0$; the reverse is true in the series $A = 4n + 2$. For odd nuclei the level density is practically independent of $|N - Z|$ up to an excitation energy of 20 eMV, but for higher excitation energies it increases with $|N - Z|$. AUTHORS.

477. Further Concentration of N^{15}. H. G. Thode and H. C. Urey. *J. Chem. Phys.* 7. *pp.* 34–39, *Jan.*, 1939.—A further study [see Abstract 5150 (1937)] has been made on the application of the chemical exchange reaction between NH_3 and NH_4NO_3 in water to the problem of securing high concentrations of N^{15}. The apparatus consists of several glass-packed columns filled with efficient packing materials arranged in cascade, such that a smaller second column operates on the product from the first and a third column operates on the product from the second. With this arrangement of columns 72·8 per cent N^{15} has been secured and sufficient quantities of concentrated material produced to investigate many of the physical properties of N^{15} and its compounds. AUTHORS.

478. Structure of Benzene. C. K. Ingold. *Roy. Soc., Proc.* 169*A*. *pp.* 149–173, *Dec.* 22, 1938.—The author first states the problem which has always been a fundamental difficulty for chemists, viz.—that the stability of the benzene nucleus has to be reconciled with its chemical transformations, while no formula, static or dynamic, is satisfactory which does not provide the ring with the approximate planarity demanded by the X-ray analysis of aromatic crystals, and by electron diffraction in benzene vapour. An attempted theoretical solution is provided in detail in which the inter-relationships between the quantum theory and the present position of the electronic theory of valency are outlined, and an attempted experimental solution is described. Theoretically it is shown that the molecule of benzene should have the full symmetry of a plane regular hexagon, this being a consequence of the equality in the proportions in which the two Kekulé, and likewise the three Dewar, structures enter into the mixed wave function for benzene. The ring is also found to be a free conductor with respect to the six electrons, which elementary valency theory would have allocated to the three bonds, now regarded as delocalised. Experimentally the above theoretical viewpoint is shown to be strictly confirmed, the data being obtained by the two general methods of electron interferometry and long-wave spectroscopy. H. H. Ho.

479. Molecular Structures of H_2S_2, $(CH_3)_2S_2$ and SCl_2. D. P. Stevenson and J. Y. Beach. *Am. Chem. Soc., J.* 60. *pp.* 2872–2876, *Dec.*, 1938.—The molecular structures of H_2S_2, $(CH_3)_2S_2$ and SCl_2 have been investigated by the method of electron diffraction. H_2S_2 and $(CH_3)_2S_2$ are chain molecules. In H_2S_2 the S–S distance is 2·05 ± 0·02 Å. In $(CH_3)_2S_2$ the S–S distance is 2·04 ± 0·03 Å, the C–S distance is 1·78 ± 0·03 Å and the C–S–S angle is 107 ± 3°. SCl_2 is a bent molecule. The S–Cl distance is 2·00 ± 0·02 Å, the Cl–S–Cl angle is 103 ± 3°.

AUTHORS.

480. Deviation of Viscosimetric from Mean Molecular Weight. G. V. Schulz. *Zeits. f. phys. Chem.* 41. *Abt. B.* 6. *pp.* 466–468, 1938.—In a previous paper [see Abstract 1926 (1936)] it has been shown that for polymolecular substances, which by the viscosimetric method (of Staudinger) have a determined degree of polymerisation P_η, the deviation from the average value P is given by the equation $P_\eta/P = \int_0^\infty P^2 h(P) dP \int_0^\infty h(P) dP$, where $h(P)$ is the frequency distribution function of the degree of polymerisation defined by the equation $dn = h(P)dP$, and dn is the number of molecules with a degree of polymerisation between P and $P + dP$ in 1 gm. mol. of the substance. This equation is now corrected and some possibilities for its application are discussed. H. H. Ho.

481. Dependence of our Knowledge of Atoms and Molecules on the Development of Technique and Apparatus. M. Bodenstein. *Naturwiss.* 26. *pp.* 833–838, *Dec.* 23, 1938.—A lecture dealing with progress in our knowledge of atoms and molecules and its dependence on the development of apparatus and methods. A. J. M.

482. Pressure-Density Diagram of the Elements at Higher Pressures and Temperature Null Point. H. Jensen. *Zeits. f. Physik,* 111. 5–6. *pp.* 373–385, 1938. *Zeits. f. techn. Physik,* 19. 12. *pp.* 563–565, 1938.—On the basis of the Fermi atomic model the pressure-density relation for several nuclear charges is numerically calculated. In connection with the model of the homogeneous electron gas the case of white dwarf stars is referred to. Several geophysical applications are considered. J. J. S.

See also Abstracts 519, 539, 561, 643, 714, 762, 789, 809.

COLLOIDS.

483. Rôle of Attractive and Repulsive Forces in Formation of Tactoids, Thixotropic Gels, Protein Crystals and Coacervates. I. Langmuir. *J. Chem. Phys.* 6. *pp.* 873–896, *Dec.*, 1938.—The formation of tactoids (small, sharply defined, doubly refracting masses of greater density than the surrounding sol) from thixotropic sols, of Schiller layers (plate like particles arranged in parallel layers having a uniform spacing), from iron oxide sols the separation of tobacco virus solutions and bentonite sols into two liquid layers, and the crystallisation of proteins are regarded as examples of unipolar coacervations (separation into two phases) involving attractive forces. It is shown that the Coulomb attraction between the micelles and the oppositely charged ions in solution is excessive and must be balanced by the dispersion action of thermal agitation and another *repulsive* force. The assumption of long range van der Waals forces is unnecessary. A maximum value of the osmotic pressure as the colloid concentration increases is the necessary condition for coacervation. Two approximations of the Debye-Hückel theory are used to discuss conditions under which coacervation occurs. Results in the case of the first approximation are fairly satisfactory. The general mathematical theory is difficult. The one dimensional case of forces between parallel colloidal platelets can be solved in terms of elliptic integrals; a simpler solution in terms of exponential functions is derived. The value of the force is of the right order to explain the stability of unipolar coacervates and to explain the Jones–Ray effect. A theoretical and experimental investigation of the relaxation of birefringence in bentonite and V_2O_5 sols is presented. J. S. G. T.

***484. Viscometer for Investigation of Effect of Irradiation on Sols. J. Löbering and K. Staunig.** *Kolloid Zeits.* 85. *pp.* 279–289, *Nov.–Dec.*, 1938.—A description is given of a viscometer designed for the investigation of the effect of u.v. irradiation on the viscosity of sols. Abnormal changes of viscosity with pressure difference can also be investigated. The performance of the instrument is tested with a range of normal liquids, for which no effect is observed on irradiation. On the other hand, in 11 out of 12 cases of abnormally-flowing sols, irradiation is found to produce a marked effect. The phenomena are examined in detail for sols of gelatin and starch and it is shown that irradiation causes a diminution of viscosity and a partial disappearance of abnormal viscosity effects. It is pointed out that the apparatus is suitable for following the dependence of the irradiation effects upon time. The bearing of the effects on practical therapy by irradiation is indicated. L. A. W.

485. Viscosity and Structure of Colloidal Solutions. W. Philippoff. *Kolloid Zeits.* 85. *pp.* 324–328, *Nov.–Dec.*, 1938.—The author discusses the measurement of the viscosity of colloidal solutions, and the derivation of constants to express the viscosity which are independent of the method of measurement. An account is given of the various structural factors which determine the viscosity, and the nature of the viscosity-concentration curve, of a sol, and methods for isolating the effects of individual factors, by varying the experimental conditions, are outlined. W. H. Wal.

486. Simultaneous Measurement of Optical Density and Viscosity of Colloidal Solutions. A. Boutaric. *Ann. Soc. Sci. de Bruxelles*, 58. *pp.* 211–224, *Dec.* 12, 1938.—The investigation of transformations in colloidal solutions and suspensions by the simultaneous measurement of the relative viscosity η/η_0, and the optical density h, is considered theoretically. It is shown that the coefficient $\omega = (1/h)\log_e \eta/\eta_0$, which reduces to $\omega = (1/h)\ (\eta - \eta_0)/\eta_0$ for solutions of low viscosity, is proportional to the number of particles per gm. of disperse material. Applications of the method to the examination of the modifications which blood-serum undergoes on heating, and to the investigation of various transformations in gum-arabic solutions, are described. W. H. Wal.

487. Cellophane. J. E. Brandenberger. *Frank Inst., J.* 226. *pp.* 797–801, *Dec.*, 1938.—The circumstances which led the author to devise practical machines for the manufacture of cellophane are outlined in relation to dyeing and mercerisation of cotton fabrics. Viscose brought to an advanced degree of maturity is sent in the form of a liquid nappe of 1·8 m. width and several tenths of 1 mm. thick into a coagulating bath which solidifies it. It is desulphured in boiling soda bleached, dyed, impregnated with glycerin and dried. 60 m./min. are so produced. The cellophane thus produced is subjected to tensions which confer upon it birefringent properties. It swells under the influence of water and absorbs 85% of its weight of moisture. When dried by saturated vapour under a pressure of 2 kg. for several hours its water absorption is altered until only 35% can be held. In an atmosphere of 60% relative humidity it absorbs about 9% of moisture. Cellophane is easily impregnated with salt solutions and ammonium chloride and bromide confer fireproof qualities thereon. Various opalescent and colour effects can be attained by the introduction of metallic salts. It absorbs water, does not cloud over with mist and is impermeable to many organic liquids such as oil, benzol, petrol, etc., and can easily be waterproofed. Cellophane sticks to itself by treatment with $ZnCl_2$ solutions and has large uses in photography, in particular for microphotography. S. G. B.

488. Correction to Statistical Theories Explaining High Value of Elasticity of Rubber. R. Houwink. *Zeits. f. phys. Chem.* 183. *Abt. A.* 3. *pp.* 209–216, 1938.—A high value of elasticity characterises not only substances having chain-like molecules in strain but also substances having molecules characterised by a three-dimensional structure. The author suggests that the interpretation of the experimental results of Meyer and his co-workers, *viz.*, that in the region of 350% extension the isothermal extension of rubber entails no change of internal energy, needs modification in accordance with Mack's molecular model. The expression for the change of internal energy or extension of the material comprises four terms, *viz.*, the energies due to (1) detachment, (2) distortion, (3) condensation and (4) crystallisation. Ordinarily for extensions below 350%, effects (1) and (2) compensate effects (3) and (4). For greater extensions effects (3) and (4) more than counterbalance effects (1) and (2). This conclusion contradicts that reached by Meyer, *viz.*, that forces of attraction play no part in the process of extension.

J. S. G. T.

489. Theory of Elasticity, Viscosity and Swelling for Rubber-like Substances. J. Frenkel. *Acta Physicochimica,* 9. 2. *pp.* 235–250, 1938. *In English.*—The nature of the characteristic elasticity of rubber and similar substances has been shown [see Abstracts 4461 (1936) and 3339 (1937)] to be due to the ability of the thread-like molecules of these substances to fold or curl by free rotation of the separate monomeric elements about the single bonds linking them together into a long hydrocarbon chain. This work is discussed now (§1) in comparison with the similar situation of an ideal gas. The mutual action between the long-chain molecules can be reduced to van der Waals forces acting between their elements, and the character of the heat motion of the thread-like molecules as offered by the van der Waals forces is treated in §2. The elastic relaxation time and the viscosity of polymers is dealt with in §3. The mechanism of swelling is considered in §4, where the view is expressed that swelling is fundamentally a process of osmotic character, due not to potential but to kinetic forces, that is, to the heat motion of the molecules of the filler, and connected not with a decrease of energy but with an increase of entropy. H. H. Ho.

490. Mechanism of Muscular Activity. J. Frenkel. *Acta Physicochimica*, 9. 2. *pp.* 251–256, 1938. *In English.*—The likeness between the elastic properties of rubber and muscles in the relaxed state refers also to the order of magnitude of the elastic stress of a stretched piece of rubber or muscle (maximum stress 12 kg./cm.). Still more significant is the likeness between the thermoelastic properties, *viz.*—that a relaxed muscle, just as rubber, is warmed by adiabatical stretching instead of being cooled like ordinary bodies. The mechanism of muscular excitation is held to consist in the formation of lateral bonds between the curling myosin molecules by some substance which remains in a chemically bound state so long as the muscle is relaxed, and the release of this substance is the immediate chemical cause of muscular excitation. The excited muscle is compared with vulcanised rubber, and the elimination above constitutes a devulcanisation process which is a specific characteristic of a living muscle, whose primary energy is that of devulcanisation or relaxation. The energy relations, kinetics of muscular vulcanisation and devulcanisation processes, and the connection between the elastic pull of a muscle and the velocity of its deformation are dealt with at length. H. H. Ho.

491. Thixotropy of Mineral Powders of Microscopic Size. H. G. F. Winkler. *Kolloid-Beihefte*, 48. 4–12. *pp.* 341–376, 1938.—The thixotropy of systems of particles of microscopic size in various liquids was investigated. It was found that all particles of laminar or rod-like form showed a high degree of thixotropy in water, whilst for approximately isometric particles of similar size, *e.g.*, quartz particles, it was absent. Smaller sizes of quartz particles in water showed thixotropy, but to a lesser extent than did anisometric particles. Thixotropy was also found in systems containing organic liquids, and was, in some cases, greater than in aqueous systems, *e.g.*, with quartz and glass particles, 1–6μ in diameter, in benzene. The author concludes that all substances, if in a sufficiently fine state of subdivision, show thixotropy in suitable liquids. W. H. Wal.

492. Electrokinesis at Metal Surfaces. H. R. Kruyt and J. Oosterman. *Kolloid-Beihefte*, 48. 4–12. *pp.* 377–430, 1938.—Phenomena accompanying the measurement of flow-potentials (E) in metallic capillary tubes are investigated. The measurement of such potentials in a capillary having low electrical conductivity enables the ζ-potential between the wall of the capillary and the flowing fluid to be determined. Smoluchowski's formula giving the relation between E and ζ is investigated in considerable detail for the case of a very dilute electrolytic solution or water flowing through a metallic capillary. In such a case, the formula indicates that when the ζ-potential is of the order $10^2 mv$ the flow potential (E) is immeasurably small; it is found however that when water or a dilute electrolytic solution is forced through an internally-silvered glass capillary or a drawn capillary tube of Pt, steel or Cu a considerable p.d. (E) is observed. This quasi-potential is observed as a p.d. between the ends of the capillary. Its value is not constant; on reducing the pressure the value of the p.d. falls slowly and not quickly as in the case of a glass capillary. Its sign is reversed on reversing the direction of flow. Its value is zero in the case of a solution composed of $10^{-4}N$ HCl + 0·1% quinhydrone. The formal correctness of Smoluchowski's formula is established for the electrolyte in the absence of polarisations. The electroosmosis of Pt sponge is immeasurably small. Electrophoresis exhibited by atomised Pt confirms results obtained by other observers. J. S. G. T.

493. Migration Velocity of Colloidal Particles in Strong Electric Fields. K. Hoffmann. *Kolloid Zeits.* 85. *pp.* 328–332, *Nov.–Dec.*, 1938.—The migration velocity of the micelles of a Wyoming Bentonite sol was determined from the path-length traversed during the discharge of a h.v. condenser. The specific migration velocity was found to increase rapidly with increasing field-strength. W. H. WAL.

494. Determination of Coagulation Points. H. A. Wannow. *Kolloid Zeits.* 85. *pp.* 332–335, *Nov.–Dec.*, 1938.—Describes an apparatus, incorporating an infra-red sensitive, vacuum photo-cell, for determining the coagulation points of colloidal solutions. An account is given of the application of the method to the investigation of kation-spreading in As_2S_3 sols, the reversal of charge in mastic sols, and the dissolution of As_2S_3 sols. W. H. WAL.

495. Structure of Non-Thixotropic Gels With Hydrophile Particles. W. Heller. *Comptes Rendus*, 207. *pp.* 1046–1048, *Nov.* 28, 1938.—Gelatin in H_2O forms a gel below and a sol above about 20°; Me-cellulose forms a sol below and a gel above about 45°. A mixture (pH 6) of 5 gm. gelatin and 2·5 gm. Me-cellulose per 100 cm.^{3} H_2O allowed to stand for 5–10 min. separates into two phases (gelatin below). If the temperature be varied from 1–20° the lower phase is a gel, from 20–50° both are liquid, above 50° the upper is a gel, *i.e.*, the two ingredients behave independently. Starting with the mixture at 35°, if the temperature be varied immediately, apparently uniform gels are obtained below 23° and above 48°. In these gels at the lower temperature it is the gelatin, at the higher the Me-cellulose which forms the solid structure, the other forming a colloidal liquid. C. A. S.

496. Supersaturation and Liesegang Ring Formation. A. van Hook. *J. Phys. Chem.* 42. *pp.* 1191–1206, *Dec.*, 1938.—Supersaturation theories of the formation of Liesegang rings are the most successful. The usual materials for Liesegang ring formation supersaturate readily and return to normal slowly. The supersaturation of Ag_2CrO_4 in various media is particularly studied. The extent of Liesegang ring formation (x) in the presence of crystal seeds of the material precipitating decreases rapidly as the number of nuclei (n) increases, and nx^2 is approximately constant over a certain range. A. J. M.

***497. High-Speed Centrifuging. J. W. Beams.** *Rev. Modern Physics*, 10. *pp.* 245–263, *Oct.*, 1938.—This comprehensive review of the subject is divided into the following sections :—A, experimental technique; B, theory of sedimentation in ideal dilute solutions; C, applications; D, separation of gases and vapours. A Bibliography of 100 references is included. W. H. WAL.

***498. Sedimentation Velocity in Simple Air-Driven Tops as Ultracentrifuges. J. W. McBain and F. A. Leyda.** *Am. Chem. Soc., J.* 60. *pp.* 2998–3002, *Dec.*, 1938.—Simple opaque ultracentrifuges capable of measuring sedimentation velocity or equilibrium in all systems with accuracy are described. They require no optical accessories, and run at constant temperature if the driving air passes through a thermostat. A simple two-piece rotor with liquid-tight seal is used with any suitable immobilising insert of which several are described. The sedimentation velocity of egg albumin in water at pH 4·63 was measured as $s_{20} = 3 \cdot 5_6 \times 10^{-13}$ in agreement with Svedberg's most recent result[6] $3 \cdot 5_5 \times 10^{-13}$.
AUTHORS.

***499. Tubular Vacuum-Type Centrifuge. J. W. Beams.** *Rev. Sci. Instruments*, 9. *pp.* 413–416, *Dec.*, 1938.—A method of spinning tubular rotors to high speeds in a vacuum is described. The rotors are spun by air-supported, air-driven turbines situated below the vacuum chamber. The maximum rotational speed attainable is set only by the bursting strength of the tubular rotor. The material to be centrifuged enters the spinning tube at the top at a continuous rate and is collected in light and heavy fractions at the bottom. The apparatus has been used for centrifuging materials in gaseous, vapour and liquid states.
AUTHORS.

500. Low-Temperature Investigations with Colloids. L. Holzapfel. *Kolloid Zeits.* 85. *pp.* 272–278, *Nov.–Dec.*, 1938.—Results of the investigation of colloids (egg-albumen, gelatin, gum-arabic, saponin, metacholesterol, myosin, sodium oleate, casein, polyacrylic acid and its ester, polyvinyl alcohol, polymetacrylamide) at temperatures of − 1° to − 180° are described. Freezing causes aggregation or dispersion of the colloid according to the concentration of the latter. In many cases the effect is partially reversible, the time taken for the return to the original state being dependent on the type of colloid. The aggregation effect depends on residual valencies or van der Waals forces, and can be increased by the presence of groups prone to association. The dispersion effect is produced by electrostatic and dipole forces. A. J. M.

501. Disperse Gases. R. Auerbach. *Zeits. f. techn. Physik*, 19. 12. *pp.* 561–562, 1938.—The formation of colloidal disperse systems of gases in liquids by dispersion processes, *e.g.*, by means of nozzles, injectors, agitation, etc., and by condensation processes, *e.g.*, by chemical, electrochemical and biological reactions, and by physical changes of state, is discussed.
W. H. WAL.

See also Abstracts **566**, **845**.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

502. Transformation of Amorphous Metal to Crystalline State. J. Kramer. *Zeits. f. Physik*, 111. 5–6. *pp.* 409–422, 1938.—In continuation of previous work [see Abstract 4803 (1937)] the amorphous metal is considered theoretically as a highly compressed gas in which ionisation energy is reduced a few orders of magnitude by the exchange effect of neighbour atoms; this assumption is confirmed by the behaviour of thin films as well as by external evidence. Further, the influence of the mutual atomic distances is shown on the height of ionisation temperature through the displacement of transformation temperature through pressure uniformly applied. Transformation due to impact of accelerated electrons on a thin amorphous layer corresponds exactly to gas ionisation. Attempts to deduce structures of such films by means of electron diffraction are not always above suspicion. The relationship postulated is confirmed by phenomena shown by some thin films; in a magnetic field the transformation temperature is altered by an amount corresponding to the Zeeman formula for duplication of spectrum lines; the decline in resistance in an electrostatic field corresponds to the Stark effect. D. R. H.

503. Orbital Electronic Lattices. R. Forrer. *Ann. de Physique*, 10. *pp.* 407–425, *Nov.*, 1938.—In the solid crystalline state there is an interaction between the orbits of the peripheral levels of neighbouring atoms. This phenomenon has been called electronic contact. These contacts are broken at the point of fusion, T. The number of these contacts, N, is given by the law of contacts, $T = F\sqrt{N}$, where F is a factor expressing the intensity of the contact. It depends on the principal quantum of the completed levels of the rare gas nearest to the element considered, and on the number of single peripheral electrons in the *p*-state. By basing the calculation of N on this and on a knowledge of the crystal lattice, the realisation of the electronic lattice has been attempted for a number of elements: Li, Na, K, Rb, Cs; Ca, Sr, Ba, Ra; Se, Te; P and I. In most cases the number of contacts and the valency are in agreement with the crystal structure and the number of peripheral electrons. [See also Abstract 4984 (1938).] C. J. B. C.

504. Problem of Exchange in Crystals. L. Hulthén. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 26*A*. 11. [106 *pp*.], 1938. *In German.*—A thorough mathematical analysis is given of the problem of a large number of equal atoms, arranged in a straight line, having one valency electron each. The interaction between the atoms is taken as a small perturbation and the possibility of ionisation is neglected. Two different methods are developed to find the eigenvalue which in the case of a positive exchange integral (ferromagnetism) is the highest and otherwise the lowest, and these two methods give very nearly the same answer. A statistical method is developed in order to obtain all eigenvalues approximately. An error in the treatment of the same problem by Bethe is pointed out. R. P.

505. Transition between Order and Disorder in Ionic Crystals. F. Laves. *Zeits. f. Elektrochem.* 45. *pp.* 2–13; *Disc.*, 14–16, *Jan.*, 1939.—The author reviews the whole problem of order and disorder transformations as they occur in ionic crystals. The various kinds of disorder are classified according to the method of ionic substitution, etc., and 22 classes are tabulated, typical examples being given for each class. Some cases of specially disordered crystals and some particular examples of order-disorder transformation are discussed. J. I.

506. Transition between Order and Disorder in Metal Phases. G. Borelius. *Zeits. f. Elektrochem.* 45. *pp.* 16–30; *Disc.*, 30–33, *Jan.*, 1939.—An historical introduction to the order-disorder problem as observed in metallic phases is followed by a systematic and detailed discussion of the various types of ordered and disordered metal crystalline lattices. A review of order-disorder transformation processes is given and the relation of the main physical properties to this problem is considered. J. I.

507. Statistics and Thermodynamics of Disorder in Crystals. W. Schottky. *Zeits. f. Elektrochem.* 45. *pp.* 33–68; *Disc.*, 68–72, *Jan.*, 1939.—The author discusses disorder in crystals from a statistical and thermodynamical point of view. The paper is divided into 4 main parts, *viz.*, (1) a review of the various cases of layer disorder and their physical interpretation, (2) general statistics of layer disorder, (3) molecular disorder, (4) cooperative disorder effects. Particular consideration is given to these states of disorder in which the disorder is of a lower degree. J. I.

508. Geometry of Discrete Vector Maps. D. M. Wrinch. *Phil. Mag.* 27. *pp.* 98–122, *Jan.*, 1939.—The geometry of finite and periodic point sets in S_1 and of their corresponding vector sets in S_2 is discussed. Methods are given for deriving from any S_2 set the complete class of S_1 sets corresponding. The application of these ideas to crystal analysis is indicated. It is shown that by means of this technique X-ray data may be used to discover crystal structures, not merely to test structures already devised. AUTHOR.

509. Precipitation in Au-Pt Alloys. C. G. Wictorin. *Ann. d. Physik*, 33. 6. *pp.* 509–516, *Nov.*, 1938.—Specimens 0·7–1·2 gm. in weight are synthesised in a h-f. furnace, annealed at 800° C. for 48 hr. and water-quenched, whereby good ductility is attained over the whole range 25–96 atomic % Pt. After drawing to 0·75 mm. wire the alloys are homogenised at 1100–1170° C. for 2 hr., and the change of resistance with time is measured after quenching from 700°, 800°, 900° and 1000° C. In the range 50–70% Pt difficulties in reproducibility are encountered owing to the extreme rapidity of the change. Results for particular quenching temperatures are plotted against composition, for $t = 3, 4, 6, 10, 12, 15, 32, 35, 90, 140, 2225$ min., etc. It is shown that the inner boundary of the metastable range may be represented by the formula $(d^2F/dq^2) = 0$, and an attempt is made to evaluate the constants in the expression F empirically. D. R. H.

510. Precision Measurements of Lattice Constants by a Compensation Method. H. van Bergen. *Ann. d. Physik*, 33. 8. *pp.* 737–752, *Dec.*, 1938.—The compensation method described by Kossel [see Abstract 3717 (1936)] and hitherto confined to single crystal antikathodes, is developed for use with external radiation. A full description of the apparatus and necessary adjustments is given. Measurements were made on the 420 and 240 reflections from Cu using Cu Kα radiation, and the results, reduced to 20° C., gave a value of $a = 3 \cdot 60751 \pm 0 \cdot 00004$ Å. The method is being applied to other crystals. A. G. Q.

511. Structure of NH_4CdCl_3. H. Brasseur and L. Pauling. *Am. Chem. Soc., J.* 60. *pp.* 2886–2890, *Dec.*, 1938.—A complete structure determination has been made of the orthorhombic crystal NH_4CdCl_3. The unit of structure has the dimensions $a_0 = 8 \cdot 96 \pm 0 \cdot 02$, $b_0 = 14 \cdot 87 \pm 0 \cdot 03$, $c_0 = 3 \cdot 97 \pm 0 \cdot 01$ Å, and contains 4 NH_4CdCl_3. The atomic positions are $xy\ 1/4$, $\frac{1}{2} + x\ \frac{1}{2} - y\ 1/4$, $\frac{1}{2} - x\ \frac{1}{2} + y\ 3/4$, $\overline{xy}\ 3/4$ of the space group $D_{2h}^{16} - P\ n\ a\ m$, with the following parameter values x, y: Cd, 0·165, 0·054; Cl_I, 0·284, 0·215; Cl_{II}, 0·167, 0·496; Cl_{III}, 0·026, 0·898; NH_4, 0·43, 0·82. The $CdCl_3$ complexes occur in the crystal as infinite polymers, in the form of double rutile strings of $CdCl_6$ octahedra parallel to the c-axis. These complexes are held together by ammonium ions, each of which has nine chlorine atoms coordinated about it. Interatomic distances in the crystal are closely related to those in $CdCl_2$ and NH_4Cl. AUTHORS.

512. Microstructure and Diffraction Pattern of Basswood Ash. E. A. Parker, W. E. Patzer and G. J. Ritter. *Am. Chem. Soc., J.* 60. *pp.* 2980–2982, *Dec.*, 1938.—The ash residue obtained from the burning of wood forms intact skeletons of the original wood. An ash residue of a transverse wood section has walls considerably thinner than those of the original wood section. As the organic material of the cell wall burns, a lateral shrinkage of the ash cell wall occurs, the ash in the secondary layer being drawn toward the middle lamella. It is believed that the occasional checks between two adjacent cell walls of the ash are caused by the sectioning of the wood and are no indication of the absence of ash in the middle lamella. Ash residues from transverse wood sections indicate that the ash-forming minerals in wood are located in both the cell wall and the middle lamella. Small blocks of the ash residue retain the shape of the original wood. X-ray diffraction patterns of ash cubes indicate a random arrangement of the ash crystals. By a comparison of the diffraction pattern of the ash with those of known compounds, it has been shown definitely that the carbonate and the oxide of calcium produced the only visible diffraction lines. AUTHORS.

513. X-Ray Study of Menthol. S. S. Sidhu. *J. of Applied Physics*, 10. *pp.* 83–84, *Jan.*, 1939.—The stable α-form of menthol crystallises in the hexagonal form with an axial ratio of 1·635; $a_0 = 11\cdot82 \pm 0\cdot02$ Å; number of molecules per unit cell is eight and the calculated specific gravity is 0·885. The diffraction data presented here should be useful in the study of inversion phenomena in menthol by X-ray methods. AUTHOR.

514. Mobile Annuli in Anisotropic Drops of *p*-Azoxyanisole Containing a Small Quantity of Phloridzine. P. Gaubert. *Comptes Rendus*, 207. *pp.* 1052–1054, *Nov.* 28, 1938.—The observation of annuli in anisotropic drops of *p*-azoxyanisole has been previously recorded [see Abstract 2244 (1938)] without mention of their mobility, and the present paper contains an investigation of the conditions for their production and of their optical properties. The anisotropic drops were produced on a glass plate or better upon a newly cut cleavage section of phlogopite, with a Pt heater of adjustable temperature. Mixtures containing from 1/150 to 1/20 of phloridzine were examined, and while the results were of the same general character the number of annuli was found to rise with the increase of added material. The phenomena differ according as the drops proceed directly from the fusion of the solid or from the cooling of the isotropic liquid, due probably to the quantity of foreign material passing into the anisotropic drop. The two cases are discussed. H. H. Ho.

515. Atomic Distribution Function for Liquid Sodium. C. N. Wall. *Phys. Rev.* 54. *pp.* 1062–1067, *Dec.* 15, 1938.—An atomic distribution function for liquid Na is developed. A simple liquid model of the quasi-solid type is assumed in which each atom is trapped by its immediate neighbours in a small spherical cell within which it is free to move about. The resulting distribution function contains three parameters which are evaluated by fitting the function to the experimental distribution curves for liquid Na given by Trimble and Gingrich [see Abstract 1409 (1938)]. An approximate value of the free volume of the liquid as a function of the absolute temperature is obtained. By means of the free energy equation the entropies and latent heats of fusion and vaporisation for liquid Na are calculated and compared with the observed values. AUTHOR.

516. Liquid Structure and Energy of Vaporisation. J. H. Hildebrand. *J. Chem. Phys.* 7. *pp.* 1–2, *Jan.*, 1939.—The equation derived by Hildebrand and Wood [see Abstract 72 (1934)] for the potential energy of a liquid in terms of its structure, as determined by X-ray scattering, has been tested by the aid of the structures determined by Thomas and Gingrich for K at 70° and 395°. The ratio of the energy of vaporisation is calculated to be 1·154 while the same ratio as determined by aid of the vapour pressure curve is 1·155. The decrease in the van der Waals *a* is the same for K and C_6H_6 for temperature intervals corresponding to equal expansion ratios. AUTHOR.

517. Transformations in Solidified Halogen Acids. A. Kruis and R. Kaischew. *Zeits. f. phys. Chem.* 41. *Abt.B.* 6. *pp.* 427–432, 1938.—Observations with the polarising microscope show that condensed HCl, HBr, and HI possess a uniform behaviour in regard to their transformations. On cooling, each acid in the solid state shows a transformation from an isotropic phase to an anisotropic phase. The transformation temperatures of HCl, HBr and HI are 99°, 117° and 126° Abs. respectively. No evidence was found for the transformations at lower temperatures which have been suggested, in the case of HBr and HI, by other methods of investigation. [See Abstract 3844 (1937).] J. I.

518. Retrograde Transformations. A. Smits. *Zeits. f. phys. Chem.* 41. *Abt.B.* 6. *pp.* 441–452, 1938.—Continuing the work on the transformation of ND_4Br [see Abstract 4309 (1938)] this paper deals with the deeper thermodynamical considerations underlying such transformations. For their occurrence two requirements are necessary: that the total heat of transformation of the internal equilibrium must change sign and that the curve representing this internal equilibrium must intersect the separation curve of the pseudo-system. It is shown that a change of sign of the total heat of transformation can only occur if the heat of reaction Q_R of the inner change $X \rightarrow Y$, which at higher temperatures is negative, becomes zero and then positive, at lower temperatures. It is also shown that if this total heat remains negative the above mentioned intersection of the two curves can never occur, whilst this intersection must occur when the total heat changes sign from negative to positive.

G. G.

See also Abstracts 659, 745, 804, 833 and

241B. Acute Tin Pest. E. Cohen and W. A. T. Cohen-de-Meester.

DENSITY.

519. Limiting Density of Ethylene. Atomic Weight of Carbon. E. Moles, M. T. Toral and A. Escribano. *Comptes Rendus,* 207. *pp.* 1044–1046, *Nov.* 28, 1938.—Deduced from actual determinations at pressures of 1, $\frac{3}{4}$, 2/3, $\frac{1}{2}$, 1/3, and $\frac{1}{4}$ atmosphere the density of C_2H_4 at pressure p is $(1\cdot25122 \pm 0\cdot000003) + 0\cdot009133_3 p$, corresponding with a limiting density of 1·251214, whence with $H = 1\cdot0081$, $C = 12\cdot007 \pm 0\cdot000_5$. C. A. S.

520. Determination of Small Differences in Density. R. Taft and L. E. Malm. *J. Phys. Chem.* 42. *pp.* 1187–1189, *Dec.,* 1938.—Describes a simple method for determining small changes in density which may occur when solutions of gelatin or of agar solidify to a gel. Under carefully controlled conditions, photographs of the meniscus produced by the specimen in the narrow neck of a pyknometer are taken before and after solidification takes place, and any change of volume is determined from a comparison of these photographs. The method also permits the change of density to be derived; changes of density of less than 1 part in 10,000 can be detected. H. B.

See also Abstracts 695, 763.

DIFFUSION AND OSMOSIS.

521. Coefficient of Diffusion of a Salt. I. W. Ramsay and R. W. B. Stephens. *Am. Phys. Teacher,* 6. *pp.* 329–333, *Dec.,* 1938.—A method of determining the coefficient of diffusion of a coloured salt (*e.g.,* $NiCl_2$) is described, and the theory is worked out. A solution of the salt is carefully run below water in a rectangular jar of uniform cross-section by means of a tap-funnel with a fine stem. The variation of the colour at different depths with time after the start of the experiment is determined by means of a photo-cell, and the concentrations are determined by calibrating the photo-cell with solutions of known concentration. The results obtained for $NiCl_2$ are in satisfactory agreement with the Noyes equation. A. J. M.

See also Abstract 801.

ELASTICITY AND PLASTICITY.

522. Large Deflections of a Thin Ring. R. A. Fairthorne. *Phil. Mag.* 26. *pp.* 1006–1017, *Dec.,* 1938.—The ring is assumed to be thin and uniform and completely circular in the unstressed state. Deformation is supposed to be inextensional, the deformation being due to flexure alone. Under these conditions deflections have been calculated accurately for certain symmetrical applications of the load. These include (1) four equal moments of alternate sign, equally spaced round the circumference; (2) two diametrically opposed concentrated loads acting (*a*) inwards, (*b*) outwards and (3) two opposed inward loads along a diameter and two equal opposed outward loads along a perpendicular diameter. A. W.

523. Flexure of Infinite Elastic Strip on Elastic Foundation. G. Bosson. *Phil. Mag.* 27. *pp.* 37–50, *Jan.,* 1939.

See also Abstracts 611, 612 and

244 B. Elasticity and Damping in Relation to State of Material. F. Forster and W. Koster.
246 B. Three-Dimensional Photoelasticity. M. Hetényi.
426 B. Steady Oscillations of Systems with Non-Linear and Unsymmetrical Elasticity. M. Rauscher.

GRAVITATION.

524. Stokes' Formula in Gravitational Theory. G. Garcia and A. Rosenblatt. *Comptes Rendus,* 207. *pp.* 969–970, *Nov.* 21, 1938.—Mathematical note continuing previous work [see Abstract 1817 (1938)]. W. S. S.

See also Abstracts 531, 549.

HYDRODYNAMICS AND AERODYNAMICS.

525. Chrono-Photography and Vortex Motion. A. Foch and C. Chartier. *Comptes Rendus,* 207. *pp.* 1163–1166, *Dec.* 12, 1938.—In the investigation of vortex fluid motion it is customary to examine the motion by the illumination of laminar particles introduced into the stream. The possibility of determining the frequency of rotation of the particles from a knowledge of the general velocity of flow and the distance between two maxima of brilliance in the photographic record is discussed and illustrated by results relating to helicoidal flow past an aileron, and the turbulent effusion of an air jet. J. S. G. T.

526. Laws of Turbulent Flow in Open Channels. G. H. Keulegan. *Bureau of Standards, J. of Research,* 21. *pp.* 707–741, *Dec.,* 1938.—The theoretical investigations of Prandtl and Kármán, and the experimental work of Nikuradse, have led to rational formulæ for velocity distribution and hydraulic resistance for turbulent flow in circular pipes. With certain assumptions regarding the effects of secondary currents and of the free surface, and with the adoption of the hydraulic radius as the characteristic length, similar rational formulæ are deduced for open channels. The validity and the applications of these formulæ are illustrated by a study of Bazin's experiments. In this study the equivalent sand roughnesses of the channels used by Bazin are determined. The criterion for determining the conditions under which a channel with wooden-plank surfaces is to be considered hydrodynamically wavy or hydrodynamically rough is also evaluated. The rational formulæ with constants determined from Bazin's experiments are expressed in the form of power laws. It is shown that Manning's empirical formula is a good approximation to the rational formula for rough channels when the relative roughness is large. AUTHOR.

See also Abstracts 536, 606, 749.

KINETIC THEORY OF MATTER.

527. Representation of Collisions between Groups of Elastic Spheres. J. R. Peter. *Helv. Phys. Acta,* 11. 7. *pp.* 587–606, 1938. *In German.*—An investigation is made into the general representation of collisions of elastic spheres, possessing two velocity ranges, within a velocity space. This leads to a geometrical derivation of Maxwell's law of velocity distribution for a mixture of two gases. R. W. P.

528. Collision Factors in Solution. R. P. Bell. *Faraday Soc., Trans.* 35. *pp.* 324–327, *Feb.,* 1939.—It is shown that both the transition state method and a simple kinetic model lead to the conclusion that the presence of a solvent should increase the collision factor for a bimolecular reaction by a factor of about 1 to 4. The available experimental data support this value rather than the value 100 to 1000 previously deduced from the transition state method. The conclusion is strictly valid only for reactions for which the activation energy in solution is the same as in the gas. For reactions involving large changes of polarity both methods of treatment predict abnormal collision factors. AUTHOR.

See also Abstract 767.

MASS.

See Abstract 531.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

***529. Small Scale Differential Analyser. H. S. W. Massey, J. Wylie, R. A. Buckingham and R. Sullivan.** *Roy. Irish Acad., Proc.* 45*A*. *pp.* 1–21, *Oct.,* 1938.—A description is given of a small-scale differential analyser containing four integrating units constructed at relatively low cost. The construction of the various units, torque amplifiers, input and output tables, etc., is described in detail, and then the performance of the machine in some preliminary tests, including simple integration, the solution of the simple harmonic equation, and of the wave equation of the H atom. AUTHORS.

See also Abstract 508.

MECHANICS, CLASSICAL.

530. General Problem of Exterior Ballistics. G. Garcia. *Comptes Rendus*, 207. *pp.* 840–842, *Nov.* 7, 1938.—Continuation of a previous paper [see Abstract 4793 (1938)]. Previously only the first and second approximations were obtained. Now taking into account the curvature of the earth the author obtains a third and fourth approximation. S. W.

531. Concept and Determination of Mass in Newtonian Mechanics. V. V. Narlikar. *Phil. Mag.* 27. *pp.* 33–36, *Jan.*, 1939.—Following Mach's exposition, Pendse has recently pointed out [see Abstract 5218 (1937)] two serious lacunæ in the definition and determination of mass. In this paper it is shown that a more penetrating analysis of Newtonian gravitation on the lines suggested by Mach himself and followed by Einstein, Eddington and Milne, in their respective theories, removes the lacunæ. The definition and determination of mass are thus shown to be unambiguous in the classical theory. AUTHOR.

See also Abstract 569.

MECHANICS, QUANTUM.

532. Kinematic Geometry Adapted to Quantum Theory. P. Février. *Comptes Rendus*, 207. *pp.* 972–974, *Nov.* 21, 1938.—The reconciliation of geometric and kinetic considerations, classically incompatible on the uncertainty principle, is discussed on the basis of reinforcing a given geometry by the addition of a system of kinetic vectors distinct from the system of geometric vectors. The coordination of pairs of propositions formed by a geometric statement and a statement on the kinetic vectors, according to whether such pairs satisfied the uncertainty relations, is then considered. An extension to moments of rotation is examined. N. M. B.

533. Classical Wave Functions for Moving Corpuscles. W. E. Benham. *Phil. Mag.* 26. *pp.* 1031–1049, *Dec.*, 1938.—A discussion of the possibility of a compromise between classical and quantum mechanics is used to initiate a mathematical examination of electron theory and the associated laws of motion. N. M. B.

534. Imaginary Unit in Dirac's Equation. O. Scherzer. *Ann. d. Physik*, 33. 7. *pp.* 591–593, *Dec.*, 1938.—Dirac's equation contains $\sqrt{-1}$ for two different reasons: owing to its occurrence in the commutation laws of quantum mechanics, and owing to the artifice of making the four-dimensional equations of relativity symmetric by adding an imaginary factor to the fourth coordinate. It is pointed out that it contributes to the clarity of the equations if the two imaginary units are kept separate and denoted by different symbols. R. P.

535. Minimum Property of Free Energy. R. Peierls. *Phys. Rev.* 54. *pp.* 918–919, *Dec.* 1, 1938.—If the expectation values of the energy are calculated for any set of mutually orthogonal wave functions, and the free energy then computed as if the energy values so obtained were the correct energy levels of the system, the result is always higher than the actual free energy. R. P.

536. Notion of Stability. M. Godefroy and H. Poncin. *Comptes Rendus*, 207. *pp.* 1161–1163, *Dec.* 12, 1938.—The stability of a mechanical system, S, is defined by 3 conditions as follows: (1) the state of the system at time t is represented by a point M in space of n dimensions; (2) there exists a stationary configuration of the system represented by the point O; (3) the evolution of the system S from a configuration M_0 is defined by the law $d\bar{M} = [\bar{\bar{a}}\bar{M} + \bar{L}(M)]dt$, in which the matrix $|| a ||$ does not depend upon t or upon the point M, and $\bar{L}(M)$ is a vector infinitesimally small compared with OM, is discussed. The analysis is based upon a comparison of the system S with another system S′ which conforms with the law $d\bar{M}' = \bar{\bar{a}}\bar{M}'dt$. The results obtained have application to the stability of a Bénard voxtex system. J. S. G. T.

537. Elementary Particle. W. Wilson and J. Cattermole. *Phil. Mag.* 27. *pp.* 84–93, *Jan.*, 1939.—In applying the equation $p_x^2 + p_y^2 + p_z^2 - m^2c^2 + m_0{}^2c^2 = 0$ of Einstein's special theory of relativity, which describes the motion of a particle in macro-physics, to the motion of a microphysical particle, such as an electron, each term in the equation is treated as an operator of the form $(h/2\pi i)(\partial/\partial x)$. In this paper a new method is given of deriving this quadratic operator from linear ones. The basis of the theory is that the path of any particle, whether charged and in an electromagnetic field or not, is a geodesic in a 5-dimensional continuum. Electrons, positrons and photons are treated as different aspects of one and the same thing and their geodesics are null geodesics in the 5-fold continuum. The photon is distinguished only by the vanishing of the component of its momentum in the fifth dimension of the continuum. G. O. B.

538. Field Theory of Elementary Particles. N. Rosen. *Phys. Rev.* 55. *pp.* 94–101, *Jan.* 1, 1939.—Previous attempts at constructing a classical field theory of the electron are reviewed and it is shown that hitherto it has not been possible to combine the two conditions: gauge-invariance and freedom from singularities. It is pointed out that this can be done by the introduction of new matter functions similar to the wave functions of quantum theory. A simple possibility of this type is considered and is found to lead to equations admitting electron-like solutions. The electron turns out to have a negative mass (but perhaps this difficulty will disappear when the equations are quantised). The theory, although classical, offers in principle a possibility of accounting for the Sommerfeld fine-structure constant. There are also solutions corresponding to excited states of the electron and to heavier particles, including particles with zero charge. AUTHOR.

539. Iteration Method and its Application to Oxygen Problem. G. Horvay. *Phys. Rev.* 55. *pp.* 70–87, *Jan.* 1, 1939.—Past calculations for nuclei heavier than He lead to approximate binding energies considerably less than the experimental values. There are two possible explanations, still in need of clarification: (1) the Hamiltonian is wrong, (2) the convergence of the variation or perturbation methods used is too slow to yield sufficiently accurate results with a reasonable amount of work. A variational method which is essentially equivalent to a perturbation calculation including first-, second-, and third-order contributions to the energy yields strong evidence for believing that in the lowest state of the selected Hamiltonian the O nucleus has a finite radius and the binding energy is greater than that of four α-particles. The Hamiltonian is assumed in the form of "Wigner's first approximation." It is the simplest form which leads to saturation. Methods of extrapolation permit an estimate of its true binding energy, and an approximate value of about 230 mc^2 is obtained. Slowness of convergence is also demonstrated. This paper is concerned with an analysis of the evidence which leads to the above conclusions. The variational method used is the " iteration method " described in an Appendix to the paper. It presents many interesting features, notably it permits an estimate of the lowest eigenvalue of the Hamiltonian. The formalism necessary for the calculation of the matrix elements is derived in other Appendices. AUTHOR.

540. Two-Body Problem. N. Svartholm. *Zeits. f. Physik,* 111. 3–4. *pp.* 186–194, 1938.—In this work a survey is given of the various types of solutions of the wave mechanical two-body problem, including a new calculation of the ground state of the hydrogen molecular ion with the help of an explicit wave function, which differs by less than 0·01% from the value obtained by the exact method. G. O. B.

541. Quantum Electrodynamics. K. F. Novobatzky. *Zeits. f. Physik,* 111. 5–6. *pp.* 292–300, 1938.—In a theoretical paper, quantisation of the electromagnetic field and the setting up of the Hamiltonian operator are carried out in a way which avoids the awkward results inherent in the usual derivation by Dirac's method. G. O. B.

See also Abstracts 474, 475, 476, 504, 657, 738, 758, 759, 850.

PRESSURE.

***542. Radiometer-Type Vacuum Gauge. A. E. Lockenvitz.** *Rev. Sci. Instruments,* 9. *pp.* 417–420, *Dec.,* 1938.—A radiometer-type vacuum gauge is described, which is rugged and simple to construct, which can be calibrated from the dimensions of the gauge, and for which the temperature of the moving system does not enter. The gauge, when constructed entirely of metal, has a range from 2 dynes/cm^2. to 0·01 dyne/cm^2. If constructed of glass, the lower limit can be extended to 0·001 dyne/cm^2. or better. AUTHOR.

***543. Protective Device for Large Vacuum Systems. J. P. Youtz.** *Rev. Sci. Instruments,* 9. *pp.* 420–421, *Dec.,* 1938.—Full details are given of a device which automatically closes a valve in the exhaust line from the diffusion pump to the mechanical pump whenever the latter ceases to turn at the normal speed. A rotary valve driven from the backing pump shaft allows puffs of compressed air to pass into a cylinder, the piston of which opens the vacuum valve. When the pump shaft stops rotating the compressed air supply is automatically shut off and springs close the vacuum valve smoothly, yet sufficiently rapidly to save the vacuum in the system. As soon as rotation of the backing pump is renewed, the valve is reopened and evacuation continues. A. G. Q.

***544. Sensitive Differential Manometer. W. Hurst.** *Rev. Sci. Instruments,* 10. *pp.* 27–29, *Jan.,* 1939.—A portable sensitive differential manometer is described. The instrument consists essentially of a train of gears from a small jewelled wrist-watch movement and a drum covered with a rubber diaphragm. The design is such as to permit the measurement of rapid and slight variations of pressure. The pressure variations may be as small as 0·0012 cm. of Hg and as rapid as 15 per sec. The above sensitivity may be increased by a factor of approximately 10 by increasing the effective volume behind the moving diaphragm. AUTHOR.

545. Production of High Vacua for Obtaining Low Temperatures. S. Zamenhof. *Physica,* 6. *pp.* 47–48, *Jan.,* 1939. *In English.*—The writer proposes the use of adsorbents, *e.g.,* active charcoal, silica gel, etc., as powerful and simple substitutes or as auxiliaries to diffusion pumps for the production of low temperatures. [See also Abstract 347 (1939).] AUTHOR.

See also Abstracts 482, 752.

RELATIVITY AND ETHER.

546. Relativity and the Representation of Phenomena in Four-Dimensional Space. J. Loiseau. *Comptes Rendus*, 207. *pp*. 974–977, *Nov*. 21, 1938.—The modification of the equations of motion in Riemannian space-time leading to the representation in four-dimensional space of the motion of particles is developed mathematically. N. M. B.

547. Imaginary Time in Special Relativity. W. Band. *Am. Phys. Teacher*, 6. *pp*. 323–324, *Dec*., 1938.—An approach is suggested to the concept of imaginary time in the Lorentz invariant interval so as to avoid the difficulty of accepting it as a mystery of the Minkowski world. It is shown that the imaginary quantity may be regarded naturally as a turning operator. N. M. B.

548. Relativistic Generalisations of the Fundamental Equations of Analytical Mechanics. B. Kwal. *Comptes Rendus*, 207. *pp*. 1028–1030, *Nov*. 28, 1938.—Following the generalisation of the Hamiltonian canonical equations by the introduction of independent variables, the generalisation is extended to various of the more simple cases by starting from a tensorial instead of a scalar variational principle. This leads to canonical equations introducing a tensorial Hamiltonian. N. M. B.

549. Gravitational Waves in Linearised Fields. B. C. Mukerji. *Phil. Mag*. 26. *pp*. 1068–1076, *Dec*., 1938.—The solutions of the first approximation of Einstein's gravitational equations are discussed with a view to finding which are also solutions of the exact equations. It is shown that for a spherically-symmetric field in empty space there are no genuine gravitational waves. All fields of this kind are reducible to flat space-time. For axial symmetry, however, the first-order equations give solutions of wave-type which do not correspond to flat space-time and which are not solutions of the exact equations. G. C. McV.

See also Abstract 538.

SOLUTION.

550. Solubility of Nitrogen and Argon in Sea Water. N. W. Rakestraw and V. M. Emmel. *J. Phys. Chem*. 42. *pp*. 1211–1215, *Dec*., 1938.—The solubility of N_2 and A in sea water containing 15–21 gm./kg. of Cl, at each degree from 0° to 23° was determined, the solubility at each temperature being determined by approaching that temperature both from above and from below. C. A. S.

551. Solubility of Barium Oxalate in Aqueous Salt Solutions. R. W. Money and C. W. Davies. *Chem. Soc*., *J*. *pp*. 2098–2100, *Dec*., 1938.—The solubility of barium oxalate dihydrate has been measured at 25° in KCl and KNO_3 solutions at concentrations extending up to $0 \cdot 1\ M$, and in dilute $MnCl_2$ solutions. The results with the first two salts have been used to calculate an equation for the mean ionic activity coefficient of BaC_2O_4. The increase in solubility produced by $MnCl_2$ is about ten times as great as with a KCl solution of the same ionic strength, and is in good agreement with the dissociation constant of MnC_2O_4 previously found from conductivity measurements. AUTHORS.

552. Isotonic Solutions. Part I. Chemical Potential of Water in Aqueous Solutions. G. Scatchard, W. J. Hamer and S. E. Wood. *Am. Chem. Soc., J.* 60. *pp.* 3061–3070, *Dec.*, 1938.—A modification for precision work of the isotonic apparatus and method of Sinclair and Robinson is described [see Abstract 4449 (1934)]. The isotonic concentrations at 25° of aqueous solutions of NaCl, KCl, H_2SO_4, sucrose, urea and glycerol have been determined from 0·1 *M* NaCl to the saturated solution or to a saturated solution of NaCl. The solubilities in water at 25° of NaCl, KCl, sucrose and urea have been determined in the same apparatus by a new and convenient method. The most precise determinations of the chemical potential of water in solutions of non-volatile solutes have been compared critically by means of these isotonic measurements, and a standard curve for the osmotic coefficients of each substance has been based on all the measurements with any of these substances. AUTHORS.

See also Abstracts 496, 528, 656, 765, 813.

SURFACE PROPERTIES.

553. Heats of Adsorption of Gases on Chromic Oxide at Low Temperatures. R. A. Beebe and D. A. Dowden. *Am. Chem. Soc., J.* 60. *pp.* 2912–2922, *Dec.*, 1938.—The heats of adsorption of A, H_2, D_2, CO, N_2 and O_2, on reduced Cr_2O_3, have been determined calorimetrically in the low temperature region. The magnitude of the heats indicates that all these gases except A are adsorbed in part in the activated state even at − 183°. The form of the time-temperature curves on a partially covered surface at −183° indicates that with CO, N_2, and O_2 the adsorption is complex, the gases initially adsorbed in the van der Waals state undergoing a slow change on the surface over into a state of activated adsorption. From the heat measurements with CO at −183° and −195° the activation energy of the above slow surface change has been estimated at 180 to 690 cal./mol. It is suggested that the rate controlling process in this slow change may be (1) a slow activated adsorption, or (2) a slow surface diffusion. The effects of CO on the heat of O_2 adsorption and of O_2 on the heat of CO adsorption have been investigated experimentally. The heats of adsorption of CO, N_2 and O_2 have been measured at 0° as well as at −183°, and the results at the two temperatures have been compared. AUTHORS.

554. Adsorption of H_2 and D_2 on Charcoal. W. van Dingenen and A. van Itterbeek. *Physica*, 6. *pp.* 49–58, *Jan.*, 1939. *In English.*—Measurements have been made on the adsorption on charcoal of D_2 and H_2 in the temperature regions 90–55° K. and 20–17° K. Between 90–55° K. the adsorption of D_2 is found to be about 8% greater than that of H_2. Between 20–17° K. this difference has increased to about 15%. It seems that this difference must be explained by a difference in potential and kinetic properties between the two isotopes (a difference in diameter being out of the question) and that the way to treat this problem is analogous to that developed by K. Schäfer, when dealing with the van der Waals attraction [see Abstract 3663 (1937)]. Between 90–55° K. the adsorption isotherms can be represented by a Freundlich equation, between 20–17° K. by a Williams equation. The results obtained cannot be brought into agreement with the potential theory of Polanyi. From the data obtained for the adsorption isotherms the heat of adsorption was calculated at various temperatures as a function of the adsorbed quantity. From this it can be concluded that there is a constant difference between the heat of adsorption of D_2 and of H_2, the adsorption heat of D_2 being higher than that of H_2 (about 180 cal.). The measurements of the adsorption were extended as far as capillary condensation, enabling the structure curve of the charcoal to be derived, from which the surface tension of D_2 was finally computed. In this way were found: 20·36° K., 0·81; 19·05°, 1·11; 17·48°, 1·70 dyne/cm. AUTHORS.

555. Adsorption at Surfaces with Congealed Thermal Equilibrium of the Active Zones. E. Cremer and S. Flügge. *Zeits. f. phys. Chem.* 41. *Abt.B.* 6. *pp.* 453–465, 1938.—An explanation is submitted as to why adsorption processes mainly do not follow the Langmuir adsorption isotherms, as theoretically anticipated, but obey a power law of the form $a = K.C^n$, where a is the adsorbed amount, C the concentration and $n < 1$. The above explanation requires the assumption of different kinds of centres on the surface, each of which possesses its Langmuir isotherm. Although little is known concerning the abundance of these separate centres, nevertheless data from catalysis (namely, from oxides of Group III of the periodic system) lead to the conclusion that upon a surface which has been heated to a certain maximum temperature T, there is an energy distribution $e^{-E/RT}$ which is frozen by cooling. Such behaviour is intelligible when the active centres are regarded as holes in the surface whose order of energy defect is E. Under the assumption of this distribution, and the further one that the adsorption energy of the single centres increases linearly with E, an exponential dependence of the frequency of the centres on the heat of adsorption is derived. The summation for all the centres can then be performed, and the final form is the power series which has been sought after, where the exponent n of the quotient is the temperature of experiment by preparation temperature of the adsorbent, *i.e.* a simple physical interpretation. Experimental data for alcohol on neodymium oxide are included. H. H. Ho.

556. Mechanical Properties of Adsorption Layers. Part I. P. A. Rehbinder and A. A. Trapeznikov. Part II. A. A. Trapeznikov. *Acta Physicochimica,* 9. 2. *p.p.* 257–312, 1938. *In English.*—The mechanical properties of adsorption layers of soluble (saponin) and insoluble (cetyl alcohol, palmitic and oleic acids) surface-active substances have been determined. The surface elasticity is obtained by measuring the angular displacement of a disc suspended on a torsion wire and placed in the surface film, and the surface viscosity is found by observing the log. dec. of the oscillations of the disc. The mechanical properties improve as the surface layer becomes more saturated and the surface is more completely covered. The stabilising action of adsorption layers on films, bubbles in foam, or drops in emulsions is a maximum at surface concentrations somewhat less than saturation. In Part II methods of determining the mechanical properties of films on substrates of varying acidity are described. The maximum strength of a palmitic acid film is 10–12 dynes per cm. The effect of ageing on the strength of palmitic acid films was investigated. The mechanical properties do not change on a markedly acid or neutral substrate, but improve considerably on a slightly acid one. Cetyl alcohol films show, on ageing, a rise in viscosity followed by a spontaneous decrease resembling gelatinisation and synæresis in colloidal systems. A. J. M.

557. Surface Tension of Dilute Solutions. W. C. Fisher and C. A. Mackay. *Canad. J. of Research*, 16. *Sect.A. pp.* 207–214, *Nov.*, 1938.—Surface tension measurements have been made on lauric acid at temperatures above its melting point, on aqueous solutions of butyric and lauric acids, and on methyl acetate and sodium oleate. The results for the solutions are compared with those calculated by means of a recent theory. [See Abstract 5235 (1937).] AUTHORS.

*558. **Tensiometer with a Flexible Metallic Sheet for Measurement of Surface Tensions. H. Lemonde.** *J. de Physique et le Radium*, 9. *pp.* 505–511, *Dec.*, 1938.—In a new tensiometer, which is described, the amount of bending of a flexible metal sheet, caused by the pull of the liquid on a rectangular wire frame suspended from the sheet, is used to evaluate the surface tension of the liquid. The bending is measured to within 1/100 mm. by fixing a micrometer objective on the sheet and viewing it through a microscope. W. R. A.

559. Liquid Droplets. E. Rumpf and E. Geigl. *Zeits. f. Physik*, 111. 5–6. *pp.* 301–313, 1938.—The vapour pressure of a small droplet is increased on account of surface tension and decreased by concentration. The radii of " equilibrium drops " held in a current of moist air were measured, and found to depend only on concentration, though not qualitatively in accordance with theory. A short section is devoted to supercooled freely floating water droplets. P. H. B.

560. Structural Characteristics of Certain Silver Films. S. F. Essig. *J. of Applied Physics*, 10. *pp.* 61–72, *Jan.*, 1939.—The structural characteristics of three types of Ag films which have found general use as photo-kathode bases in television image analysers and similar electronic devices are discussed. They are classified as mosaics and translucent films. Two types of mosaics are discussed, (1) the reduced oxide dust film, and (2) the agglomerated sputtered or evaporated film. A characteristic of the first is a wide range in particle size (<1–30μ in films photographed), those below 3 μ being greatest in number. A critical temperature, approx. 600° C., is observed in reduction of the oxide films above which there is a distinct liquid phase in the Ag–Ag_2O system resulting in a radical change in the final film structure. The process of agglomeration is traced from the continuous through the mosaic state in the second type film. The characteristics are a smaller and more uniform particle size than the reduced oxide type. Particle size and spacing is readily controlled and reproduced. The range in initial thickness of films investigated is approximately 0·01–0·2 μ. The third type of translucent film is a composite consisting of a silver mosaic superposed on an electrically conducting film of relatively high light transmission. Pt is chosen as the most suitable metal for this sub-film and is protected from destructive forces such as oxidation and alloying with the Ag mosaic by an intermediate film of SiO_2 or Al_2O_3. AUTHOR.

561. Minimum Distance of Approach Between Atoms. B. N. Sen. *Gazz. Chim. Ital.* 68. *pp.* 656–661, *Oct.*, 1938.—In previous work the author proposed the expression $D = P/E_i d^{k/v}$ which gives results in agreement with experiment but is incorrect dimensionally ; P being the parachor, E_i the ionisation potential, d the atomic diameter, v the valency, and k a constant $= 1 \cdot 58$. He therefore suggests a modification $D = f_2 \cdot f_1(v) \cdot P/E_i d^{k_1}$, in which $f_1(v)$ is dimensionless, f_2 can be considered as a constant with dimensions $[M^{0 \cdot 5}/L^{0 \cdot 575}T]$. For monovalent elements $f_2 \times f_1(v) = 0 \cdot 615$, for divalent elements $1 \cdot 166$, for trivalent elements

$1 \cdot 05$, k_1 has then the value $0 \cdot 925$. The following is a comparison with experimental results—

Element	P	Atomic Diameter	E_t	D calculated	D found
Ti	45·3	2·80	6·80	2·99	2·96
Zn	50·7	2·65	9·35	2·57	2·67
Pb	76·2	3·80	7·39	3·50	3·48
Cu	46	2·74	7·69	2·74	2·54
Cd	70	3·84	8·95	2·76	2·96
Ca	68	4·30	6·09	3·38	3·93
Ni	50	2·70	8·65	2·69	2·50
Li	50	2·01	5·37	3·00	3·03
Na	80	2·53	5·12	4·07	3·72
K	110	3·14	4·32	5·43	4·50
Sb	66	2·58	8·35	3·45	3·37
Al	38·6	2·70	5·96	2·71	2·86

[See also Abstract 132 (1939), and following Abstract.] D. R. H.

562. Parachors and Velocity of Sound in Metals. B. N. Sen. *Gazz. Chim. Ital.* 68. *pp.* 662–664, *Oct.*, 1938.—In the propagation of sound in metals, the particle responsible for the perturbation is the atom, the velocity is therefore a function of the parachor, which represents the volume of an atom at constant surface tension, or a constant of auto-compression due to internal cohesion. The author deduces the following expression for the velocity of propagation—

$$\mathrm{L}\left(\frac{\sqrt{a}}{2\pi}\sqrt{\frac{\mathrm{P\text{-}V}}{\mathrm{N}}\cdot\frac{ve^2}{\gamma^3}\cdot\frac{\mathrm{N}}{\mathrm{M}}}\right)\left(f_2\times f_1\,(v)\cdot\frac{\mathrm{P}}{\mathrm{E}_t d^{k_1}}\right)$$

in which V is the atomic volume, M the atomic weight, N the Avogadro number, L, k_1 and $\sqrt{a}$, dimensionless constants with values $2 \cdot 54$, $0 \cdot 925$, and $0 \cdot 415 \times 10^{12}$, $f_2 \times f_1(v)$ a constant depending on the valency v, f_2 having dimensions $[\mathrm{M}^{0.5}/\mathrm{L}^{0.575}\ \mathrm{T}]$. The first factor in the expression represents the frequency of vibration of the atoms, and the second the nearest distance of approach between them. Values calculated in this way are in fairly good agreement with experimental results for Ni, Zn, Pb, Cu, Hg, Cd, Al. [See preceding Abstract.] D. R. H.

563. Nature of Foam. Part II. Foam Formation of Ternary System, Acetic Acid—Ethyl Ether—Water. T. Sasaki. *Chem. Soc. Japan, Bull.* 13. *pp.* 669–678, *Dec.*, 1938.—A continuation of previous work [see Abstract 4368 (1938)].

564. Wetting and Adhesion of Bubbles. Part I. A. Frumkin. *Acta Physicochimica*, 9. 2. *pp.* 313–326, 1938. *In German.*—In general, the curve relating surface tension and area per mole for a layer of liquid on a solid shows both a maximum and a minimum. A theory of the stability of thin layers is developed on this basis, and the significance of the theory in connection with the adhesion of bubbles is explained. [See following Abstract.] P. H. B.

565. Wetting and Adhesion of Bubbles. Part II. A. Frumkin and A. Gorodetzkaja. *Acta Physicochimica*, 9. 2. *pp.* 327–340, 1938. *In English.*—It is shown experimentally that bubbles adhere instantaneously to an uncharged Hg surface in a solution containing an electrolyte, and that adhesion is hindered by decrease of concentration and increase of surface charge. The relations between the kinetics of adhesion and the contact angle after break are in qualitative agreement with the theory of the stability of thin layers as developed in Part I [see preceding Abstract], assuming that the stabilising effect of an electric double layer upon a thin layer of water is in the main caused by the electrostatic repulsion of ions from the free surface of the water. P. H. B.

566. Influence of Structure of Adsorption Films on Adhesion of Microscopic Particles. A. v. Buzágh. *Kolloid Zeits.* 85. *pp.* 318–324, *Nov.–Dec.,* 1938.—The influence of various organic compounds, and of colloids, on the adhesion of microscopic particles to flat surfaces was investigated by the break-away angle method. In the presence of strong electrolytes, the properties of the electric double-layer were found to determine the adhesion, while in the case of weak and non-electrolytes, the inter-molecular forces between adsorbed molecules were determinative. For alcoholic solutions a close relationship between the adhesive forces of the particles and the dielectric molecular polarisation of the solution was found. The adhesion of charged quartz particles (+ or −) to a quartz plate in the presence of solutions of fatty-acids varied with the orientation of the adsorbed polar molecules. Colloids, including proteins, were found to have a characteristic influence on the adhesion, which reached a maximum at the iso-electric point. The method may be used to determine the iso-electric point of colloids. Information as to the nature of the adsorbed films of colloidal material was also obtained. W. H. Wal.

567. Formation of Microscopically Visible Asphaltic Products During the Ageing of Grease Oils. L. G. Sabrou and E. M. Renaudie. *Comptes Rendus,* 207. *pp.* 1050–1052, *Nov.* 28, 1938.—This investigation deals with alterations which occur in grease oils for internal combustion motors, when kept during 40 hours at a temperature of 150° C. The products formed under these conditions are easily discerned under the microscope at low magnifications, and 4 principal types have been distinguished, photographs of which are included in the paper. The evolution of their growth is progressive and thereby explains the simultaneous presence of two different types in the same oil. The microscopic method is recommended when dealing with oils of this character. H. H. Ho.

568. Electrical Properties of Stearate Films Deposited on Metal. E. F. Porter and J. Wyman, Jr. *Am. Chem. Soc., J.* 60. *pp.* 2855–2869, *Dec.,* 1938.—The potentials of X and Y films in contact with polar liquids are neutralised by contact with the liquids, but reappear when the films are separated from the liquids. The potentials are not, however, neutralised in benzene. Contact potentials induced in X and Y films by exposure to a glow discharge are not destroyed by dipping the films in mercury. Y films however lose their induced potential in H_2O or $CHCl_3$. The potential-layer curve is displaced by applying a voltage between the slide and the liquid while the film is being formed. X and Y films containing Pb are anomalous. X and Y films do not differ in impedance or breakdown voltage. [See Abstract 2743 (1938).] A. J. M.

See also Abstracts 487, 545, 573, 816, 880 and
240B. Hydrodynamic Theory of Lubrication. W. Frössel.

TIME.

***569. Isochronism of Pendulums and Balance Wheels. K. Giebel.** *Zeits. f. Instrumentenk.* 58. *pp.* 499–506, *Dec.,* 1938.—The causes of lack of isochronism in free and escapement-driven pendulums and balance wheels are enumerated, and their effects on performance are discussed. P. H. B.

***570. High Speed Mechanical Recorder. H. V. Neher.** *Rev. Sci. Instruments*, 10. *pp.* 29–31, *Jan.*, 1939.—A mechanical recorder is described having a resolving time of $0\cdot8 \times 10^{-3}$ sec. It will follow regularly spaced pulses at the rate of 1200 per sec. and should miss no more than 1% of pulses spaced random in time at an average counting rate of 10 per sec. A circuit is also described giving a pulse of short enough duration and at the same time of sufficient magnitude to operate the recorder satisfactorily. AUTHOR.

See also Abstract 870.

VISCOSITY AND FRICTION.

571. Viscosity of Nonpolar Liquids. S. Kyropoulos. *J. Chem. Phys.* 7. *pp.* 52–57, *Jan.*, 1939.—The phenomenon of viscosity drop by flow-orientation (*i.e.*, mechanical orientation in a Couette apparatus) with nonpolar liquids composed of large dissymmetrical molecules points to a marked influence of the dissymmetry of polarisability on this phenomenon and on viscosity in general. In the case of such liquids the molecular forces of interaction are practically confined to the dispersion forces, and there are very definite states of minimum mutual potential energy. This condition results in temporary formation of complexes of higher saturation of those residual fields of force which interact in the phenomenon of viscosity. An analogous case is represented by long chain hydrocarbon molecules with polar head where the dipole forces are eliminated to a great extent, insofar as viscosity is concerned, by association, resulting in a viscosity behaviour very similar to that of corresponding paraffins. With small molecules, even small permanent moments tend to suppress the influence of the anisotropy of polarisability of deformation, resulting in a type of complex which is ultimately, even temporarily, more determined by the dipole forces. AUTHOR.

***572. Measurement of Anomalous Viscosity. C. F. Goodeve.** *Journ. Sci. Instruments*, 16. *pp.* 19–27, *Jan.*, 1939.—A new form of viscometer is described in which the fluid is placed in a rotating container with a conical inner surface. A viscous drag is imparted to a coaxially suspended or pivoted inner cone, and the torque produced measured by means of a torsion wire or spring. The rate of shear is altered by a movement of one of the cones relative to the other along the axis, thus altering the separation between the moving surfaces. The instrument is especially designed for the measurement of anomalous viscosities. Very high rates of shear may be obtained without the occurrence of turbulent flow. AUTHOR.

573. Viscosity and Surface Tension. C. A. Buehler. *J. Phys. Chem.* 42. *pp.* 1207–1209, *Dec.*, 1938.—Souders' constant I [see Abstract 999 (1938)] is shown empirically to equal 1·2 times the parachor when the latter is independent of temperature. It follows from Souders' equations and the parachor relationship that in these circumstances $\log_{10}(\log_{10}\eta) = 1\cdot2\gamma^{\frac{1}{4}} - 2\cdot9$. P. H. B.

See also Abstracts 480, 484, 759.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***574. New Sun-Earth-Moon Model. W. G. Colgrove.** *Roy. Astron. Soc. Canada, J.* 32. *pp.* 405–409, *Nov.*, 1938.—The author describes the instrument as a unique combination of simplicity and ruggedness, only one approximate proportion being included—that of the diameters of earth and moon—as proportion is not essential. The complete model is 4 ft. long, 2 ft. wide, 2½ ft. high and weighs only a few pounds. A strong electric lamp represents the sun, its light being constantly directed towards the earth by a reflecting hood ; it has a wire equator attached to it, so that " the aim of the sunspots, when present, may be indicated." He enumerates the features that it can demonstrate. A. S. D. M.

***575. Follow-Up Drives for Astronomical Observing Instruments. W. Bischoff.** *VDI* 82. *pp.* 1393–1398, *Dec.* 3, 1938.—This article comprises an outline survey of the principles and apparatus which have been applied to the speed regulation of the power drive of large astronomical instruments required accurately to follow up the motions of the stars as observed from the earth. The scope of the survey is indicated by the following list of sub-headings : governors for gravity drives, static and astatic ; governors for electrical drives, synchronous motor drive ; photo-electric follow-up ; drive control by pendulum clock. Copious references are given to original papers and to books on this subject. J. E. K.

***576. 82-Inch Mirror of McDonald Observatory. J. S. Plaskett.** *Astrophys. J.* 89. *pp.* 84–98, *Jan.*, 1939.—Visual tests of the 82-in. mirror made at the centre of curvature give a maximum departure of only 0·7 millionths of an inch (0·02 μ) from the true paraboloid. The photographic Hartmann test gave slightly larger departures, but this is caused by the greater accidental errors of the measures. The Hartmann criterion T equals 0·05. The zonal aberrations are all satisfactorily small, and there is no measurable astigmatism. AUTHOR.

***577. Suitability of New Photo-Cell for Astrophotometry. P. Görlich and E. J. Meyer.** *Zeits. f. Astrophysik,* 16. 5. *pp.* 343–366, 1938.—Photo-cells with transparent composite photo-kathodes of a type produced by one of the authors [see Abstract 4412 (1936)] are being developed for astrophotometry. The characteristics of these cells especially in respect of sensitivity and dark currents are measured and compared with corresponding data for K photo-cells. The superiority of the former for astrophotometry is established. The particular application considered is the direct measurement of light from extremely faint stars. J. E. K.

See also Abstract 689.

COMETS AND METEORS.

578. Reflectivity and Colour of Meteorites. F. G. Watson. *Nat. Acad. Sci., Proc.* 24. *pp.* 532–537, *Dec.*, 1938.—From the spectral-reflectivity curves for meteorites, seven stony and one metallic specimen, it is concluded that (1) meteorites are essentially gray-bodies with colour indices less than + 0·2 magnitude ; (2) their geometrical albedoes probably range from 0·1 to 0·5 ; (3) metallic and stony materials are probably indistinguishable on the basis of colour data. AUTHOR.

COSMOGONY.

See Abstract 582.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

579. Keplerian Orbits in the Field of a Nucleus Radiating Mass. H. K. Ganguly. *Calcutta Math. Soc., Bull.* 30. *pp.* 35–44, *June*, 1938.—The motion of a particle in the gravitational field of a body which loses matter proportionately to the cube of its mass is worked out in detail and Jeans' result confirmed. If the orbit of the particle is quasi-elliptic at any instant it will remain so indefinitely. G. C. McV.

LATITUDE AND LONGITUDE.

580. Harmonic Analysis of Latitude Variations. S. Nakano. *Imp. Acad. Tokyo, Proc.* 14. *pp.* 312–315, *Dec.*, 1938. *In English.*—Observational material obtained at three international stations, Mizusawa, Carloforte, and Ukiah, during the period 1900-1919, is harmonically analysed. The data used are the deduced coordinates of the instantaneous pole, and the observed latitude of the three stations. The values of $\Delta\phi$ are treated in two series with different initial epochs, 24 harmonic terms being used. The amplitudes and phase angles for the principal terms are in good accordance in the two series. Using mean values for $\Delta\phi$, the coordinates of the pole are derived, and compared with the international results. When the polar motion is resolved into several elliptic harmonic motions, the direction of each principal component motion is found to be the same as that of the actual motion. The principal terms are of periods nearly 14 months, nearly 12 months, and one much longer; of which only the first is due purely to polar motion. A. Hu.

NEBULÆ.

581. Inclinations of Spiral Nebulæ to Line of Sight. F. G. Brown. *Roy. Astron. Soc., M.N.* 99. *pp.* 14–16, *Nov.*, 1938.—For spiral nebulæ of not less than 4′ dia. the Shapley-Ames catalogue confirms the apparent excess of small inclinations found by the writer in the Reinmuth catalogue. Below 4′ the limiting magnitude of 13·0 tends to exclude increasing numbers of spindles relatively to round spirals. The latter catalogue, however, shows that the excess persists down to 2′ dia., while the small nebulæ in Fath's list confirm its existence at least down to 30″. Whatever its cause, it is not peculiar to any particular catalogue. [See also Abstract 1509 (1938).] AUTHOR.

582. Metagalactic Density Gradient. H. Shapley. *Nat. Acad. Sci., Proc.* 24. *pp.* 527–531, *Dec.*, 1938.—In a previous note [see Abstract **3993 (1938)**] the author discussed the increase in the number of galaxies per square degree down to apparent magnitude 18 in a 30° zone across the south galactic pole, the plates having been brought to a common magnitude limit by means of Seares and van Rhijn tables. These tables have now been found untrustworthy in this region. If unreduced numbers of galaxies are used the density-gradient across the cap is reduced. Reasons, however, are given for believing that the gradient really exists even if it is not quite as conspicuous as originally suggested. G. C. McV.

583. Observations Made with the Nebular Spectrograph of the McDonald Observatory. O. Struve and C. T. Elvey. *Astrophys. J.* 89. *pp.* 119–124, *Jan.*, 1939.—16 spectrographic observations of 15 fields reveal emission lines in 8 fields. No emission was found in the luminous rims of dark nebulæ in Taurus, in the nebula B 14, or in NGC 884 (one member of the double cluster in Perseus). Two loose clusters north of the double cluster show very conspicuous emission, as does also the galactic cluster NGC 7380. [See Abstracts 2749 and 4401 (1938).]

AUTHORS.

PLANETS.

584. Atmospheres of Planets. H. Spencer Jones. *Nature,* 142. *pp.* 1019–1022, *Dec.* 10, 1938.—If velocity of escape is 5 times the mean H_2 molecular velocity, the atmosphere of a cool planet should be immune from loss. The moon, however, has none and Mercury's is very tenuous. The earth should be immune, but is losing He, probably through the effect of the metastable state of O_2 in the upper atmosphere; O_2 is being replenished by vegetation. Mars' O_2 is almost locked up in the iron rocks, but it has slight vegetation. The major planets have atmospheres of H_2, He and such, mixed with CH_4, NH_3 and H_2O, and little or no CO_2 or free N_2. Jupiter's and Saturn's NH_3 is in the form of droplets, and is frozen out of the atmospheres of more distant planets. Small planets have no atmospheres; middle-sized ones have moderate ones without H_2 or its compounds; large ones have great atmospheres with H_2 and its compounds, but with no O_2 or its compounds. A. S. D. M.

585. Total Lunar Eclipse, Motion Pictures. W. H. Christie and W. Miller. *Roy. Astron. Soc. Canada, J.* 32. *pp.* 401–404, *Nov.,* 1938.—The authors took pictures of the Lunar eclipse of May 23, 1938, which occurred at midnight on the Pacific coast. They used the 10-in., f.45. Cooke refractor on an Eastman Panchromatic Super X Standard Motion-Picture film in conjunction with a No. 29 by 12 filter which limits light to a narrow region of the red spectrum; exposure times were 1/50 sec. for the uneclipsed moon and 5 sec. for earth-limb portion (which was dark as lunar eclipses go). The film speed was reduced to 1 ft./min. or a 90-times reduction. A plate is given of the eclipsed moon. A. S. D. M.

See also Abstracts 574, 579, 616.

STARS.

586. Stellar Parallaxes Determined at the Royal Observatory, Greenwich. *Roy. Astron. Soc., M.N.* 99. *pp.* 49–51, *Nov.,* 1938.—A continuation of the relative parallaxes obtained with the 26-in. refractor [see Abstract 521 (1938)].

587. Stellar Parallaxes Determined Photographically at the Royal Observatory, Cape of Good Hope. (Tenth List.) *Roy. Astron. Soc., M.N.* 99. *pp.* 52–58, *Nov.,* 1938.—The form of publication is similar to that of previous lists [see Abstract 522 (1938)].

588. Absolute Magnitude and Reduced Proper Motion. Mean Errors in Spectroscopic Absolute Magnitudes of G- and K-Stars. G. Strömberg. *Mt. Wilson Observat. Contrib. No.* 603. *Astrophys. J.* 89. *pp.* 10–25, *Jan.,* 1939.—A study has been made of the corrections to be applied to the spectroscopic absolute magnitudes (M_s) for the case in which the stars are to be grouped on a neutral or impartial basis of grouping. The stars studied are of spectral types G0–G7 and G8–K2. They have been grouped both on the basis of M_s itself and on the basis of

$H = m + 5 \log \mu$, a quantity which is correlated with the absolute magnitude (M). In this study the spectroscopic distinction between giants and dwarfs has not been utilised, and some of the regression effects studied by Russell and Moore [see Abstract 2760 (1938)] are thus partly obliterated. Mean values and dispersions in the absolute magnitude have been derived for the two methods of grouping with the aid of Schlesinger's list of trigonometric parallaxes. The systematic errors are found to be small, and the two methods of grouping give practically the same results. The dispersion in M_s has been found in most cases to have been underestimated. The mean error of the individual value of M_s has been found to be between 0·5 and 0·6 magnitudes. Formulæ are derived for the computation of mean absolute magnitudes from trigonometric parallaxes, for the derivation of the dispersion in M, and for the determination of mean errors in the individual values of M_s. The existence of giants and dwarfs is clearly shown when the grouping is made on the basis of H. There are distinct discontinuities in the functional relationship between M and H, the presence of which is obviously independent of the relative proportions of stars of different apparent magnitudes and proper motions used in the investigation. AUTHOR.

589. Southern Stream and the K Term. P. S. Lall. *Roy. Astron. Soc., M.N.* 99. *pp.* 42–48, *Nov.*, 1938.—The mean value of K is found to be 4·2 km./sec. from radial-velocity solutions of the solar motion and the K term, in which no assumption has been made in regard to the position of the solar apex. A "local" value of K determined for the southern-stream region for B-type stars is found to be 7·2 km./sec. The convergents C_R corresponding to $K = 1·4$, 4·2, 7·2, and 9·0 are examined with reference to the proper-motion convergents of Kapteyn (C_K) and of Plaskett and Pearce (C_P). It is found that $K = 1·4$ leads to no correspondence between C_R and the proper-motion convergents. If the local value of 7·2 for this region is taken without sacrificing the value of 4·2 for the whole sky. it is found that the mean of C_K and C_P is a very good fit. This point is coincident with the solar vertex, but it is not necessary to identify the stream motion with solar motion until further light on the peculiar velocities of the 132 B-type stars forming the stream is obtained.
A. Hu.

590. Balmer Discontinuity in B, A and F Supergiants. D. Barbier, D. Chalonge, F. Schahmanèche and N. Morguleff. *Comptes Rendus*, 207. *pp.* 895–897, *Nov.* 14, 1938.—Results from 160 stars of types Od to F8 show a clear absolute magnitude effect when values of the Balmer discontinuity in supergiants are compared with those in normal stars. For B0 and B1 types, little difference is exhibited; from B2 to A2, supergiants show a smaller discontinuity than main sequence stars; whilst in F supergiants a greater discontinuity occurs. The results are not in accord with Unsöld's theory, which predicts an absence of correlation between discontinuity and absolute magnitude. Emission-line stars up to type B3 also show a smaller discontinuity than is normal for their spectral class.
A. Hu.

591. Cyanogen in Stars of Early Type. N. Morguleff. *Comptes Rendus*, 207. *pp.* 967–969, *Nov.* 21, 1938.—The spectra of a number of stars of spectral types between K0 and A0 were examined and a maximum at 3590 Å was identified with the head of the first band of the system ${}^2\Sigma - {}^2\Sigma$ of CN. The existence of CN in stars both of advanced and early types is indicated. W. S. S.

592. Wave Lengths in Spectrum of Antares. D. N. Davis. *Astrophys. J.* 89. *pp.* 41–83, *Jan.*, 1939.—A table of wave-lengths, intensities and identifications of lines in the spectrum of Antares for the region λλ 3600–6600 has been compiled. The table is described and is accompanied by explanatory notes. [See also Abstract 2335 (1938).] AUTHOR.

593. Star Models with Variable Polytropic Index. A. S. Eddington. *Roy. Astron. Soc., M.N.* 99. *pp.* 4–13, *Nov.*, 1938.—The paper is an investigation of the general properties of models in which the polytropic index increases from a value n_1 at the centre to n_2 at the surface. The author examines to what extent the solution for such a model lies wholly between the solutions representing the n_1 and n_2 polytropes. Since it is found that the solution is not always intermediate, the problem is investigated of finding maximum and minimum values of quantities in which the astronomer is interested, *e.g.*, the ratio of the central density to the mean density. It is found that the extremal values are always contained in the series of two-phase models with indices n_1, n_2. The general significance of the problem and of the results is explained. AUTHOR.

594. Interstellar Matter. C. Bertaud. *Bull. Astronomique*, 11. 3. *pp.* 157–180, 1938.—A review of the present state of our knowledge of interstellar matter, as derived from stationary lines, suggests that our local system is pervaded with a rarefied gas, homogeneous to a first approximation, and consisting of electrons and of atoms and ions of Ca, Na, and perhaps Ti. Other unidentified lines are discussed. The matter is stationary with respect to the mean of the stars, and it participates in galactic rotation; but certain portions show residual velocities which suggest the presence of local currents. A. Hu.

595. Statistical Investigation of Stellar Chains. Part I. V. Oberguggenberger. *Zeits. f. Astrophysik*, 16. 5. *pp.* 323–332, 1938.—The author considers whether the appearance of chains of stars in stellar photographs is the result of a real cosmic development, or is a mere accident of projection. The term " stellar chain " is strictly defined, certain conditions as to brightness and separation of the component stars, total length of chain, and relation to the general stellar background being stipulated. Examples are given from the Franklin-Adams chart. A systematic search for such objects on plates taken within 92° of the N. pole with a wide-angle lens, the limiting magnitude attained being 12·5, revealed 338 chains, 195 of which can be identified on the Franklin-Adams chart. A statistical discussion shows how they are distributed in galactic longitude and position angle, and indicates a correlation between position angle and galactic longitude. A. Hu.

596. Density Condensations of Cepheid Variables. Z. Kopal. *Roy. Astron. Soc., M.N.* 99. *pp.* 33–39, *Nov.*, 1938.—Using the period-luminosity and mass-luminosity relations and assuming Cepheids to radiate like black bodies, the mean densities have been calculated for 88 δ Cephei stars and 30 variables of the RR Lyræ type. The discussion of the material has led to the following results:—(1) there is no systematic relation between $P\sqrt{\rho_m}$ and the period; (2) there is a well-defined relation between $P\sqrt{\rho_m}$ and the spectrum, which would mean—provided the hypotheses involved in the present state of the pulsation theory of Cepheid variables are correct—that the density condensations of Cepheids depend widely on their spectral class; (3) there is an evident gap in the values

$P\sqrt{\rho_m}$ between short- and long-period Cepheids, suggesting probably a similar gap in the corresponding period-spectrum relation. AUTHOR.

597. Comparison Sequence for Nova Lacertæ. S. A. Mitchell and C. A. Wirtanen. *Roy. Astron. Soc., M.N.* 99. *pp.* 40–41, *Nov.*, 1938.

598. Parallaxes of Eclipsing Variables Determined by the Use of the Mass-Luminosity Relation. G. Durand. *Bull. Astronomique,* 11. 3. *pp.* 137–156, 1938.—The mass-luminosity law of Eddington can be used as an additional relation for the calculation of the parallaxes of eclipsing binaries with two observable spectra. The resulting parallaxes for 22 binaries are calculated, the parallax for each component being given. G. C. McV.

See also Abstracts 482, 583, 672, 725.

SUN.

599. Technique of Solar Granulation Photography. P. ten Bruggencate. *Zeits. f. Astrophysik,* 6. 5. *pp.* 374–378, 1938.—The most important practical details to be observed in obtaining good photographs of solar granulation are summarised. These include: protection of caelostat mirror from sun until moment of exposure, use of infra-red radiation, reduction of objective aperture by diaphragm to 10 cm. dia., use of radiation in best-corrected region of objective, use of the finest-grained paper and the shortest practicable exposure time. Two of the best granulation photographs so far obtained at the Potsdam Institute for Solar Physics are reproduced. J. E. K.

600. Optical Study of Solar Corona Photographs of June 8, 1937. B. O'Brien, H. S. Stewart, Jr., and C. J. Aronson. *Astrophys. J.* 89. *pp.* 26–40, *Jan.*, 1939.—By using isophote contours of eclipse negatives made by Stevens, it is shown that the diffuse luminosity observed by him is actually part of the corona and is not of atmospheric origin. The contours are nearly circular and differ greatly from the visual appearance of streamers in the corona. It is shown that the corona has nearly spherical symmetry and that the streamers are only slight, though abrupt, transitions in brightness superimposed on the main luminosity. Their visual prominence is due only to a well-known property of the eye. This is further demonstrated by a laboratory experiment in which true brightness contours are compared with visual appearance. AUTHORS.

601. Recent Sunspot Spectra. H. D. Babcock. *Nat. Acad. Sci., Proc.* 24. *pp.* 525–527, *Dec.*, 1938.—A method of photographing the spectra of sunspots in the region $\lambda\lambda$10,000–11,200 is described. It is found that the Paschen series lines of H and the principal multiplets of C, O, S and P are all weakened in the spot. Sr^+ is strengthened and no evidence of Cs is found, whilst other elements show little change. Many lines of Ti are enormously strengthened. A number of new lines, not found on the solar disc, are now discovered in the spot. The new apparatus is also being used to photograph the u.v. spectra of sunspots. G. C. McV.

602. Atmospheric Absorption of Infra-red Solar Radiation at Lowell Observatory. Part I. A. Adel. *Astrophys. J.* 89. *pp.* 1–9, *Jan.*, 1939.—Previous work has dealt with the complete opacity of the earth's atmosphere ($\lambda > 14\ \mu$) created in part by ν_2 of CO_2 and in the main by the rotation spectrum of the water-vapour molecule. In the present paper it is experimentally demonstrated that the influence of the rotation spectrum of water vapour extends down to $\lambda < 8\ \mu$. Provisional absorption coefficients are specified which describe the degree of opacity enforced by this spectrum between 8·34 and 13·40 μ. The absorption coefficient is then applied to the determination of the form of the solar energy curve in interplanetary space throughout this spectral interval. Satisfactory agreement obtains between this experimentally derived form and the black body curve for 6000° or 7000° K. [See also Abstract 4013 (1938).] AUTHOR.

603. Relative Abundance of CN, C_2, CH, NH, and OH in Solar Reversing Layer. F. E. Roach. *Astrophys. J.* 89. *pp.* 99–115, *Jan.*, 1939.—The partition functions of all possible diatomic arrangements of H, C, N, and O are computed. From the partition functions and the observed solar intensities of rotational lines in the bands of CN, C_2, CH, NH, and OH, the values of log $S \cdot f$ are determined, where S is the molecule's abundance and f is the absolute intensity factor. On the assumption that f is the same for all the molecules considered and is equal to 10^{-3}, values of log S are recorded. The values of log S of this paper are systematically higher than those of Russell, the difference increasing in the order OH, NH, CH, CN, and C_2, for which Δ log S (Roach *minus* Russell) is 1·1, 1·9, 3·9, 4·5, and 5·5, respectively. From CN (λ 3883) the excitation temperature of the sun is found to be 5630° ± 500° K., and from OH (λ 3064) 4640° ± 550° K. AUTHOR.

604. Oxygen Triplet at λ 7774 in Solar Spectrum. H. v. Klüber. *Zeits. f. Astrophysik*, 16. 5. *pp.* 318–322, 1938.—It has frequently been suggested that the O triplet at λ 7774 does not show the full Doppler displacement caused by solar rotation, owing to the superposition of undisplaced terrestrial absorption. From 5000 separate measurements of plates taken with the 12 m. plane grating of the Potsdam tower telescope (resolving power 80,000 ; dispersion 1 mm. = 1·36 Å) it is concluded that within the errors of measurement, the normal shift is shown. The methods used in measuring and reducing the plates are described in detail. The plates were all taken with the sun high, but a further investigation is projected to find whether a correlation exists between the intensity and breadth of the lines and the altitude of the sun. A. Hu.

See also Abstracts 574, 869.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

See Abstract

385B. Geophysical Measurements. V. Fritsch.

HYDROSPHERE, PHYSICS OF THE.

605. Temperatures and Currents in Ocean Beds. G. Wüst. *Gerlands Beitr. z. Geophys.* 54. 1. *pp.* 1–8, 1938.—The observations are briefly stated on which the author's chart of bottom temperatures and currents of the world's oceans is based. The results are then discussed in some detail, in particular as regards the spread of Antarctic cold water into the northern hemisphere in four streams and to a less distance in three other streams. C. A. S.

606. Instability of Heavy Liquid, Rotating without Relative Motion about a Solid Nucleus. M. Brillouin. *Comptes Rendus*, 207. *pp.* 816–819, *Nov.* 7, 1938.—When a heavy liquid surrounds a uniformly rotating solid, no configuration of the liquid, motionless in reference to axis on the turning solid, is stable. Consequently the free surface of oceans in relation to continents is unstable and cannot be used as a surface of reference for geodetic operations. W. A. R.

607. Currents in North Channel of Irish Sea. J. Proudman. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 4. *pp.* 387–403, *Jan.*, 1939.—A Carruthers drift-meter was operated from the Skulmartin Light Vessel, which is situated about 3·7 km. from the Irish coast of the North Channel. The meter was calibrated partly in an experimental channel and partly in the tide-way of the Mersey. Its record at Skulmartin was taken twice daily for a period extending over a year. Monthly and annual mean values of the daily drift have been evaluated, but the results indicate that the station cannot be regarded as representative of the North Channel. A method of harmonic analysis, applicable to the observations, is developed. Formulæ are evolved for the standard errors of the quantities determined. The method and formulæ are applied. The results show large standard errors in the observations themselves, and rather small amplitudes for the harmonic constituents. The harmonic constants are compared with those of the tidal heights at Liverpool, and the results appear to be in general agreement with expectations from dynamical considerations. AUTHOR.

608. Seiches in an Ocean Surrounding an Island. G. R. Goldsbrough. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 4. *pp.* 404–415, *Jan.*, 1939.—It is shown that under certain assumptions there exist seiches with definite periods of vibration in an open sea surrounding a circular island or an elliptic island. The implications of the assumptions are examined. Four sets of seiches of different types for an elliptic island are completely calculated and the co-range lines shown diagrammatically. Finally, a comparison is made with the observed seiches at Honolulu. AUTHOR.

See also Abstract 613.

LAND, PHYSICS OF THE.

609. Earth's Crust and its Deformations. C. Mailles. *Bull. géodésique, No.* 57. *pp.* 72–75, *Jan.–Feb.–March*, 1938.—Between the solid lithosphere and liquid pyrosphere is, at a depth of the order of 20 km., a layer (the " tectosphere ") at a temperature of $\nless$ 200°, which will vary in temperature owing to rise or fall of the isogeotherms consequent on sedimentation or erosion in the lithosphere. The consequent variation in viscosity will cause adjustment to be by jumps rather than uniform, relief at any one point being accompanied by diminution in pressure, and consequently in viscosity, and in opposition to further relief. C. A. S.

610. Distribution of Helium and Radioactivity in Rocks. N. B. Keevil. *Am. J. Sci.* 36. *pp.* 406–416, *Dec.*, 1938.—The He, Ra and Th contents of the minerals of Quincy granite, and the ages deduced in each case were separately determined, being $(86 \pm 5) \times 10^6$ years for quartz, the same for riebeckite and aegirite, but $(49 \pm 3) \times 10^6$ for felspar. The significance of these results is discussed, and the figure for felspar considered to be due probably to excessive crystal imperfection. Comparison of the radioactivity and He content of the various minerals in the same sample of rock, and in samples of the Quincy granite from various localities shows that there is no tendency for the He to diffuse from its place of origin. C. A. S.

611. Elasticity of Rocks and Massive Minerals. F. Birch and D. Bancroft. *Am. J. Sci.* 37. *pp.* 2–6, *Jan.*, 1939.—The results of dynamical measurements of elastic constants at ordinary pressure and temperature are reported for a few rocks and massive minerals. The elasticity of the massive pyrite and magnetite specimens is discussed in terms of the elastic coefficients of single crystals of these materials. AUTHORS.

612. High Pressure Behaviour of Minerals. P. W. Bridgman. *Am. J. Sci.* 37. *pp.* 7–18, *Jan.*, 1939.—Calcite is found to have two new transitions at high pressure, one running at about 14,000 kg./cm^2. nearly independent of temperature between 0° C. and 200° C., and the other running from about 17,000 at 0° to 28,000 at 200°. The compressibility is roughly measured up to 50,000. The compression of quartz glass is measured up to 50,000; it is found that the previously known abnormal increase of compressibility with rising pressure abruptly ceases at about 35,000, and from here on compressibility decreases with rising pressure as is normal. The compressibility of basalt glass becomes nearly constant between 25,000 and 50,000. Explorations up to 50,000 to find new transitions of a number of common minerals are described, mostly with negative results. Exploration for new modifications is also made by the shearing method; it is probable that there is a transition for pyroxenite. Finally, wurtzite is found to be irreversibly changed to sphalerite by shearing at room temperature. AUTHOR.

613. Erosion of Sands. L. J. Tison. *Ann. Soc. Sci. de Bruxelles*, 58. *pp.* 225–235, *Dec.* 12, 1938.—The minimum velocity (v) of flow that causes erosion was determined for water of various depths (d) with differing sized sand grains (diameter r) at the bottom of the stream. For $r = 0{\cdot}15$ to $0{\cdot}2$, $0{\cdot}25$ to $0{\cdot}3$, $0{\cdot}3$ to $0{\cdot}4$ and $1{\cdot}0$ to $1{\cdot}5$ mm., and $d =$ 0 to 50 cm., v first increases, attains a maximum—approximately 23, 25, 27 and 38 cm./sec. respectively for the above sizes of grains,—for $d =$ about 20 cm., then decreases until $d =$ about 40 cm., whereafter in the only case examined (for $r = 0{\cdot}15$ to $0{\cdot}2$ mm.) it appears to remain constant. C. A. S.

See also Abstract 628.

METEOROLOGY.

614. Daily Variations of Mean Temperature of Atmospheric Ozone. A. Vassy and E. Vassy. *Comptes Rendus*, 207. *pp.* 1232–1234, *Dec.* 12, 1938.—The investigation was carried out at Ifrane, Morocco (33°31′ N. 5°7′ W., altitude 1635 m.) from 19th July to 13th Aug., 1937. The experimental procedure was to photograph the spectrum of light diffused from the zenith. Four or five spectra were taken during an afternoon and from each of these the thickness and the mean temperature of the O_3 were deduced. A table shows the numerical values obtained. A study of the synoptic charts covering the same period shows that the O_3 values are dependent upon the origin of the air masses. The authors consider therefore that this whole series of results indicates a method

which reveals the circulation of masses of stratospheric air, and that these carry their characteristics along with them for a considerable time.
A. E. M. G.

615. Components of Yearly Variation of Sunshine Duration. V. Conrad. *Helv. Phys. Acta,* 12. 1. *pp.* 38–49, 1939. *In German.*

616. Calculation of Lunar Atmospheric Tides from Barometer Readings. J. Bartels. *Gerlands Beitr. z. Geophys.* 54. 1. *pp.* 56–75, 1938.—The methods for computing lunar diurnal variations in geophysical phenomena are discussed and examined with respect to their efficiency in eliminating non-lunar variations. Atmospheric tides have hitherto been calculated from long series of hourly or bi-hourly readings of barograph records; these, however, are not available in certain regions. Barometer-readings at fixed hours are freer from instrumental defects and available in larger number. However, the satisfactory determination of the lunar effect from such readings, in the usual manner, needs several hundred years of observations, even for tropical stations. The reason is found in the fact that the main lunar semi-diurnal wave, in the readings taken at a fixed solar hour, appears as a wave with the period of half a month, which is hidden by much larger semi-monthly parts in the non-periodic pressure variations connected with the changing weather situations. The unfavourable influences, however, can be neutralised by the use of differences of such readings at fixed hours. It is shown that, at the tropical station Daressalam, the semidiurnal lunar wave can be computed in this way from a few years' observations with three readings per day.
AUTHOR.

617. Chinese Air Mass Properties. Chang-Wang Tu. *Roy. Meteorolog. Soc., J.* 65. *pp.* 33–51, *Jan.,* 1939.—This paper presents the properties of the various air masses hitherto found in China; but since it is based on soundings of only four stations the picture is inevitably incomplete. Further soundings at selected stations will eventually lead to the discovery of some new air masses; but at least some of the generalisations arrived at in this paper will probably stand, though the quantitative aspects may have to be modified in the light of new materials. The paper is mainly devoted to the discussion of the properties of the air masses, other important problems such as inversions and the interaction of air masses not being touched; but both of these problems are discussed in a longer paper shortly to be published by the Institute of Meteorology, Nanking.
AUTHOR.

618. Torrential Rains in Tunis. C. Bois. *Comptes Rendus,* 207. *pp.* 1064–1066, *Nov.* 28, 1938.—A torrential rain is defined as one giving a depth of at least 30 mm. in 24 hr. The present note gives a *résumé* of the frequency of such rains. Observations from 80 stations functioning continuously between 1918 and 1937 are examined. A table has been compiled showing the annual mean frequency of rains of 30, 40 . . . 100 mm. at each station. Part of the table is reproduced. The greatest frequency occurs in the north. As the frequency decreases rapidly with increase of amount of precipitation, an empirical formula is given which enables the frequency of any particular amount at a station to be calculated from that of 30 mm. The results so found are, in the author's opinion, satisfactory to a first approximation at least.
A. E. M. G.

619. Weather Phenomena of Colorado Rockies. R. L. Ives. *Frank. Inst., J.* 226. *pp.* 691–755, *Dec.,* 1938.—From field observations in the mountain region of Colorado, it was determined that the major portion of the state's moisture is brought in by the winter cyclones. Winter winds redistribute the snow, and Chinook winds remove a portion of it from the mountain regions and adjacent plains. Summer storms of three types tend to redistribute the moisture derived from melting snow. Two types, of almost daily summer occurrence, the regional and local or valley storms, are topographically-confined convection phenomena, which daily transfer small amounts of moisture across divides. Cyclones tend to augment the violence of both other types; anticyclones inhibit the regional storms, but have a negligible effect on the local storms. Numerous barometric, electrical, and optical phenomena of great interest but minor climatic importance are briefly described. Hypotheses explaining the various major and minor phenomena are presented, and possible applications of the results of this and further studies of mountain weather conditions are suggested. AUTHOR.

620. Scattering of Light by Particles in Air. H. Grisollet. *Comptes Rendus*, 207. *pp*. 1117–1119, *Dec*. 5, 1938.—The author discusses further the results of experimental work previously described [see Abstract 3622 (1938)], and compares the distribution of scattered light, as found experimentally, with that to be expected on the basis of Mie's theory. W. H. WAL.

621. Blueness of Sky and (*a*) Polarity of Air, (*b*) Gradient Wind. J. H. Brazell and J. S. Farquharson. *Meteorolog. Office, Prof. Notes, No*. 85. [10 *pp*.], 1938.—Observations of the blueness of the sky at Aberdeen, Valentia and Kew have been examined in relation to (*a*) polarity of the air and (*b*) gradient wind. With regard to the relationship with polarity, it is found that at Aberdeen and Valentia the blueness of the sky increases with the polarity of the air, the increase being well marked at Aberdeen. At Kew this increase of blueness with polarity does not exist. The fact that the blueness of the sky does not increase with polarity at Kew, as it does at the other two observatories, can be attributed to the much greater atmospheric pollution at Kew. With regard to the relationship with gradient wind, it is found that at Aberdeen and Valentia there is a definite increase of blueness as wind speed increases. This increase of blueness with wind speed is not so well marked at Kew. At the three observatories there is a close connection between blueness of the sky and wind direction. In general winds from populated and industrial areas produce pale blue skies and winds from rural areas produce deep blue skies. AUTHORS.

See also Abstract 602.

SEISMOLOGY.

622. Japanese Deep-Focus Earthquakes. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 4. *pp*. 424–455, *Jan*., 1939.—Ten deep-focus earthquakes in or near Japan are discussed. They provide evidence that the hypothesis of a sudden increase of velocity corresponding to the 20° discontinuity is nearer the truth than that of a smooth time-curve; but the P observations suggest that continuous refraction, strong enough to produce a loop in the time-curve, is closer still. The observations of S at short distances yield a satisfactory solution for Sd, since the uncertainty of identification is much less than that found in normal earthquakes. Corrections to the times of Sr and SKS are found. Comparison of the pP − P and sS − S intervals with those calculated from the focal depths found from P alone suggests corrections to the thicknesses of the upper and intermediate layers; these thicknesses are now found to be 15 ± 3 km. and 18 ± 4 km. AUTHOR.

623. Two Double Earthquakes. R. Stonely. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 4. *pp.* 461–468, *Jan.,* 1939.—Two earthquakes from the same epicentre both show an abnormal frequency of P residuals of about $+20^s$. Analyses of residuals and examination of the Kew seismograms show that both earthquakes are double, a feeble first shock succeeded by a strong one, in each case between 19 and 20 sec. later. For the shock in which the two onsets are the more clearly separated it is shown that the two are referable to the same focus. A comparison is made with a normal earthquake from an epicentre very close to the others. AUTHOR.

624. Ellipticity Correction and Deep-Focus Earthquakes. K. E. Bullen. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 4. *pp.* 469–471, *Jan.,* 1939.—The effect of abnormal depth of focus on earthquake ellipticity corrections is examined, and for P waves it is shown that in most cases the effect is less than 0·1 sec. and only very rarely can exceed 0·2 sec. For all present practical purposes the depth of focus may be completely ignored in estimating ellipticity corrections. AUTHOR.

625. Experimentally Determined Dynamic Shears in a Sixteen-Storied Model. L. S. Jacobsen and R. S. Ayre. *Seismological Soc. of America, Bull.* 28. *pp.* 269–311, *Oct.,* 1938.—The paper discusses the dynamic behaviour of a 16-storied building model representing an idealised office building. The model is subjected to "standardised" types of ground motion, and the dynamic shears between adjacent stories are measured. The rigidity of the first story is varied so that the effect of a "flexible" first story on the dynamic shears is demonstrated. It is concluded that flexibility in the first story decreases the dynamic shears everywhere in the building when the same degree of "tuning in" with the ground-motion frequency is postulated. Moreover, it is concluded that current practice design rules are in fair agreement with the shears that may be expected when the building is vibrating in or near its fundamental mode, but that current practice does not allow for shears due to the higher modes unless a comparatively flexible first story is used. AUTHORS.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

626. Ionisation by Vaporisation. G. Lovera. *N. Cimento,* 15. *pp.* 377–383, *June,* 1938.—Reference is made to Medi's experiments on the rapid vaporisation of water [see Abstract 129 (1938)]. The author of the present paper describes experiments on the rapid vaporisation of water and several different liquids by a method similar to that of Medi. The results of these experiments lead to the conclusion that the phenomenon of vaporisation alone, when not accompanied by concomitant mechanical actions, does not cause liberation of ions. J. J. S.

***627. A.C. Apparatus for Measuring Small Magnetic Moments. E. A. Johnson and A. G. McNish.** *Terr. Mag.* 43. *pp.* 393–399, *Dec.,* 1938.—A method of measuring the moments of small magnetic dipoles is described. The dipole to be measured is rotated inside a fixed coil, and the voltage induced in the coil is measured by means of an a.c. amplifier. The limiting sensitivity is computed from the calculated signal-voltage and the thermal agitation in the input-circuit. In the practical application the theoretical sensitivity is approximately obtained and moments of 3×10^{-7} c.g.s. unit can be detected and with a specimen 1·5 cm. on a side 8×10^{-8}

c.g.s. unit/cm^3. can be detected. The method has been applied to the measurement of the polarisation in sedimentary deposits. AUTHORS.

628. Magnetisation of Marine Sediments. A. G. McNish and E. A. Johnson. *Terr. Mag.* 43. *pp.* 401–407, *Dec.*, 1938.—The direction of magnetisation was determined in varved Pleistocene clay originally deposited in glacial lakes, obtained from various depths in the deposit and therefore presumably deposited at different times. The variations observed are best explained as due to differences in the direction of the earth's magnetic field at the times of deposition. Marine deposits (" blue mud " from the Labrador current) similarly examined, pointed, though less evidently, to the same explanation. C. A. S.

See also Abstracts 671, 778.

RADIOACTIVITY.

***629. Hydrodynamic Model for Demonstrations in Radioactivity. J. L. Bohn and F. H. Nadig.** *Am. Phys. Teacher*, 6. *pp.* 320–323, *Dec.*, 1938.—A description is given of tanks designed to illustrate the laws of radioactive disintegration and the subsequent building up of disintegration products. The volumes of water in the containers at any time correspond to amounts of radioactive elements, and any of the equations of accumulation and decay may be experimentally illustrated, and the conditions of transient and secular equilibria can be shown. The tanks have glass fronts and the shape of the curved metal side is deduced mathematically. The tanks can be used singly or in series, and orifices for the outflow of water are of various sizes corresponding to different values of the disintegration constant. The use of the apparatus is described, and graphs illustrating the verification of the various laws are given and discussed. N. M. B.

630. Velocity of Disintegration of Polonium Hydride. E. Adler. *Akad. Wiss. Wien, Ber.* 147. 2*a*. 5–6. *pp.* 197–207, 1938.—Through the action of Mg powder on acid salt Po solutions Paneth and his co-workers have shown the existence of a hydride of Po. Through arrangement of the disintegration vessel as ionisation chamber capable of being directly connected to an electrometer it was now possible to examine quantitatively the chemical disintegration of the Po hydride. The gas is first dried by means of a cooling mixture. The disintegration vessel, a pear-shaped glass, is coated with a silver mirror, which by a fused-in Pt wire can be brought to a voltage or earthed. The chemical decomposition of the Po hydride was measured at 34·5° C. and 0° C. and after a definite time (for 34·5° C. after 1½ hr.) the velocity of disintegration is extraordinarily small. The dried hydride is much more stable than the moist gas, its disintegration velocity increases with higher temperature. Po hydride is very sensitive towards air, a behaviour analogous to that of Te hydride. The disintegration proceeds with very small temperature coefficient; the chemical decomposition can therefore be viewed not as a mono-molecular reaction but as a reaction of the first order. J. J. S.

631. Rn and Th Contents in Closed Air Spaces. E. Rumpf, W. Fogy and W. Fröhlich. *Ann. d. Physik*, 33. 8. *pp.* 723–732, *Dec.*, 1938.—In determining the Th content of air from caves and cellars, difficulties arise from the sparsity of the Th, the dampness and the Rn content. Three independent methods of determining the Th content have therefore been developed. They are the activation method, a method in which a sample of air is drawn off from the measuring space in the ionisation chamber and a method in which the total ionisation is measured. Good agreement is obtained between the results from the various methods. In the cases investigated the ionisation strengths, produced by the Rn and Th together with the products of decay, are approximately as nine to one. G. O. B.

632. Chemical Properties of Element 43. Part II. C. Perrier and E. Segrè. *Accad. Lincei, Atti,* 27. *pp.* 579–581, *June* 3, 1938.—A simple method of extracting the element from the bombarded Mo is described. So far as known, the chemical properties of the sulphides, fractional crystallisation, extraction with ether, volatility and reduction with $SnCl_2$, are reviewed; with special attention to the possibilities of separating element 43 from Re, Mo. Zr, Nb, and P^{32}. Sulphides of Mn, Fe and Zn precipitated in alkaline solution can be used as collectors, with efficiency decreasing in that order. [For Part I see Abstract 5294 (1937).] D. R. H.

633. Artificial Activity of Th. E. Rona, H. Scheinchenberger and R. Stangl. *Akad. Wiss. Wien, Ber.* 147. 2*a*. 5–6. *pp.* 209–215, 1938.—Further investigation have been undertaken in an attempt to clarify the genetic relationships between the transformation processes which occur on irradiation of Th with neutrons. In agreement with other results it was found that an Ac-isotope with half value period of 12 min. resulted from the 1 min. bodies. Determinations of the energies of the neutrons producing the various results showed that the 1 min., the 12-min. and also the 3·5 hr. products were produced chiefly by fast neutrons, while a very much less percentage of the activity is due to the effect of the slow neutrons. Cd, Ag and Au filters appeared to have no effect on the activity. Some 75 to 80% of the activity of the 25-min. product, resulting through slow neutrons, is found to be traceable to thermal neutrons. G. O. B.

634. β-Ray Spectra of Radioactive Sb and Na. T. Amaki and A. Sugimoto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers,* *No.* 853. *pp.* 1650–1657, *Nov.*, 1938. *In English.*—The β-ray spectra of radioactive Sb and Na were obtained by means of a cloud chamber situated in a magnetic field. Na gives a spectrum which can be resolved into two components. The end points are: for Sb^{120}, 1·53 eMV; Sb^{122}, 1·64 eMV; and Na^{24}, 0·81 and 1·76 eMV. AUTHORS.

635. Neutron-Induced Cd-Radiation. R. Fleischmann. *Zeits. f. Physik,* 111. 5–6. *pp.* 281–291, 1938.—In order to determine the composition of the γ-radiation produced from Cd by bombardment with slow neutrons, an investigation of the secondary electrons was undertaken. Observations of the absorbability of the γ-rays show that no weak constituents of comparable intensities are evident. The absorbabilities of the coincident γ-rays were measured in Pb. From the yield of coincidences a conclusion was reached on the number of emitted quanta. The emission of electrons from Cd was investigated and it was found that thin Cd layers emit only less primary electrons. The coefficient of the inner photo-effect together with the inner pair formation is found to be approximately $(0{\cdot}18 \pm 0{\cdot}12) \times 10^{-2}$. G. O. B.

636. Resonance Processes in Disintegration of Boron by Protons. B. Waldman, R. C. Waddel, D. Callihan and W. A. Schneider. *Phys. Rev.* 54. *pp.* 1017–1020, *Dec.* 15, 1938.—The yields of long range α-particles and γ-rays from the disintegration of B by protons having energies from 150 to 195 ekV were measured simultaneously. The shapes of the yield curves indicate that the yields for the two processes are proportional and that the resonances occur at the same voltage, to within 1 ekV. A determination of the α-particle yield places the resonance point at 165 ± 4 ekV. Thus it is highly probable that both resonance processes involve the same level in the excited C^{12} nucleus. The unsatisfactory findings of Oppenheimer and Serber [see Abstract 1958 (1938)] are therefore probably not due to their assumption concerning the association of the resonances with the same energy level of the compound nucleus. The half-breadth of the α-resonance was estimated to be 6 ekV, and could be accounted for by the spread in energy of the ion beam. Thus the estimates of Oppenheimer and Serber concerning the sharpness of the resonance processes are here supported. AUTHORS.

637. Proton-Induced Radioactivities. Part II. Ni and Cu Targets. C. V. Strain. *Phys. Rev.* 54. *pp.* 1021–1025, *Dec.* 15, 1938.—Ni bombarded with 6·3 eMV protons shows activities of half-lives of 10·5 ± 0·6 min., 3·4 ± 0·3 hr., and 12·8 ± 0·8 hr., corresponding to known periods of Cu^{62}, Cu^{61}, and Cu^{64}, respectively. The reactions are principally of the *p-n* type but there is evidence that in the case of Cu^{62} proton capture occurs at energies below the *p-n* threshold. The maximum β-ray energies obtained by absorption method are 2·8, 1·2 and 0·68 eMV for Cu^{62}, Cu^{61} and Cu^{64}, respectively. Thick target excitation curves are given. Cu bombarded with 6·3 eMV protons shows two activities of half-lives 38·3 ± 0·5 min. and 235 ± 20 days due to Zn^{63} and Zn^{65}, respectively. Both must be formed by *p-n* reactions. The Zn^{63} positrons have a maximum energy of 2·3 ± 0·15 eMV. Thick target excitation curve shows a threshold proton energy of 4·1 ± 0·1 eMV in good agreement with the energy relations. Average (thick target) cross-section for the $Cu^{63}(p\text{-}n)Zn^{63}$ reaction is $0{\cdot}28 \times 10^{-25}$ cm². For protons of energy 6·1 eMV it is $0{\cdot}95 \times 10^{-25}$ cm. [See Abstract 1951 (1938) and following Abstract.] AUTHOR.

638. Proton-Induced Radioactivities. Part III. Zn and Se Targets. J. H. Buck. *Phys. Rev.* 54. *pp.* 1025–1030, *Dec.* 15, 1938.—Zinc bombarded with 6·5 eMV protons shows activities of half-lives 18·0 ± 0·5 min., 72 ± 4 min., 9·4 ± 0·2 hr., and 84·4 ± 2·0 hr., corresponding to the known periods of Ga^{70}, Ga^{68}, Ga^{66}, and Ga^{67}, respectively. In addition, a new period of 48 ± 2-min. half-life is observed and assigned to Ga^{64}. Thick target excitation curves are given for Ga^{64}, Ga^{68}, and Ga^{70}. Se bombarded with 6·3-eMV protons shows activities of half-lives 6·3 ± 0·2 min., 17·4 ± 0·5 min., 4·4 ± 0·3 hr., and 33 ± 1 hr., corresponding to the known periods of Br^{78}, Br^{80} (2) and Br^{82}, respectively. The previously observed discrepancy between the thresholds for the two Br^{80} activities and their maximum β-ray energies has been confirmed. Thick and thin targets excitation curves were obtained. The cross-section for the production of the Br^{80} isomers by the Se^{80} (*p-n*) reaction are 0·82 and $0{\cdot}22 \times 10^{-25}$ cm². for the short and long periods, respectively, at a proton energy of 6·3 eMV. The ratio of these two cross-sections rises from 3·6 at 6·3 eMV to over 200 at 3·2 eMV. [See preceding Abstract.]

639. Artificial Disintegration and Radioactivity. Part II. G. Guében. *Ann. Soc. Sci. de Bruxelles*, 58. *pp.* 248–273, *Dec.* 12, 1938.—Results obtained in 1937, not previously reported, and the first results of 1938 are summarised. [For Part I see Abstract 1111 (1938).] C. A. S.

640. Angular Distribution of Particles in Disintegration $D + D = H^3 + p$ and $B^{11} + p = Be^8 + \alpha$. H. Neuert. *Zeits. f. techn. Physik*, 19. 12. *pp.* 576–578, 1938.—Using voltages up to 200 ekV, the angular distribution of the particles produced in the disintegrations $D + D = H^3 + p$ and $B^{11} + p = Be^8 + \alpha$ was found to vary greatly with the voltage. The ratio of the number of particles at 10° to the incident beam to the number at 90° varies from 1·3 at 40 ekV to 1·7 at 200 ekV for the former reaction and from 1·2 to 1·95 from 140 ekV to 200 ekV for the latter reaction. The results can be explained in terms of s- and p-interaction, according to the theory of Reinsburg. F. C. C.

641. γ-Radiation from Boron Bombarded by Deuterons. E. R. Gaerttner, W. A. Fowler and C. C. Lauritsen. *Phys. Rev.* 55. *pp.* 27–30, *Jan.* 1, 1939.—By a method already described, the γ-ray spectrum from $B + D$ has been obtained by observing the positron-electron pairs ejected from a thin lead lamina (0·033 cm.) and the recoil electrons from a carbon lamina (0·12 cm.). γ-ray components with quantum energies $1·5 \pm 0·2$, $2·2 \pm 0·3$, $4·4 \pm 0·3$, $6·9 \pm 0·4$ and $9·1 \pm 0·4$ eMV are indicated with relative intensities $> 2·5 : 2·5 : 1·0 : 0·3 : 0·1$. An attempt is made to correlate the energies and relative intensities of the observed γ-ray components with those of the proton and neutron groups. AUTHORS.

642. Radioactive Isotopes of Cu, Zn, Ga and Ge. R. Sagane. *Phys. Rev.* 55. *pp.* 31–38, *Jan.* 1, 1939.—A study has been made of the radioactive isotopes produced in Cu, Zn, Ga and Ge by bombardment with both fast and slow neutrons. Some of the isotopes were also produced by deuteron bombardment. The results may be summarised in the following table of decay periods.

Element	*Mass No.*	*Sign*	*Half-life*	*β-Ray Energy*	*γ-Ray*
Nickel	63	e^-	$2·5 \pm 0·3$ hr.	medium	—
Copper	62	e^+	$10 \pm 0·5$ min.	hard	γ
Copper	64	e^-	$12·8 \pm 0·3$ hr.	soft	γ
Copper	66	e^-	5 ± 1 min.	medium	—
Zinc	63	e^+	35 ± 3 min.	hard	γ
Zinc	65	e^+	210 ± 30 min.	very soft	γ
Zinc	69	e^-	57 ± 3 min.	hard	—
Gallium	68	e^+	66 ± 2 min.	hard	γ
Gallium	70	e^-	20 ± 1 min.	hard	—
Gallium	72	e^-	$14·1 \pm 0·2$ hr.	hard	γ
(Gallium	74?	e^-	6 ± 1 day	—	—)
Germanium	69	e^+	30 ± 3 min.	hard	—
Germanium	71	e^+	26 ± 3 hr.	medium	γ
Germanium	75	e^-	81 ± 3 min.	medium	—
Germanium	77	e^-	8 ± 1 hr.	—	—
Arsenic	71	e^+	50 ± 3 hr.	soft	γ
Arsenic	73	e^+	88 ± 2 min.	medium	γ
Arsenic	74	e^-	16 ± 2 days	medium	γ
Arsenic	77	e^-	55 ± 5 days	very soft	γ

The writer failed to find the Cu^{61} ($e^- T = 3·5h$) suggested by the Michigan group in fast neutron bombardments of Cu. No trace of the 23-hr. period reported by Fermi and his collaborators was found in neutron bombardments of Ga. AUTHOR.

643. Widths of Nuclear Energy Levels. J. H. Manley, H. H. Goldsmith and J. Schwinger. *Phys. Rev.* 55. *pp.* 39–46, *Jan.* 1, 1939.—Neutron absorption measurements with Rh both as absorber and detector have been performed, in order to obtain information about the levels of the compound nucleus responsible for the 44″ period of Rh. The absorption curves have been analysed by assuming a single sharp resonance and taking into consideration the angular distribution of the neutrons emerging from the source and the absorption of the neutrons and the electrons in the detector. This analysis yields the values: (*a*) 6100×10^{-24} cm^2. for the capture cross-section at resonance; (*b*) 0·17 eV for the total width; (*c*) $1{\cdot}6 \times 10^{-3}$ eV for the neutron width. AUTHORS.

644. Radioactivity Induced by Nuclear Excitation. Part I. Excitation by Neutrons. M. Goldhaber, R. D. Hill and L. Szilard. *Phys. Rev.* 55. *pp.* 47–49, *Jan.* 1, 1939.—It is shown that the 4·1-hr. period of In can be produced by nuclear excitation of In and is to be attributed to an excited metastable state, In^{115*}, of the stable In^{115}. This result is obtained by studying the radioactivity produced in In by neutrons of different energy distributions and by studying the chain reactions produced in Cd by fast neutrons. It is found that In^{115*} can be produced from In^{115} by 2·5-eMV neutrons, but not noticeably by strong sources of photoneutrons which have energies of a few hundred thousand electron volts. A radioactive Cd^{115} of 2·5-day half-life time is found to transform with emission of negative electrons into In^{115*}. Cd^{115} was produced by neutron loss from Cd^{116} and by neutron capture from Cd^{114}. [See following Abstract.] AUTHORS.

645. Radioactivity Induced by Nuclear Excitation. Part II. Excitation by Protons. S. W. Barnes and P. W. Aradine. *Phys. Rev.* 55. *pp.* 50–52, *Jan.* 1, 1939.—Radioactive In resulting from proton bombardment of In exhibits negative electron emission which decays with a 4·1-hr. half-life. Proton bombardment of Cd does not produce this activity. It is ascribed to a metastable excited state of In^{115} designated by In^{115*} formed by a new type of proton excitation process. Control experiments exclude the possibility of its being formed by stray neutrons. The cross-section for protons of 5·8 eMV is about 10^{-29} cm^2. [See preceding Abstract.] AUTHORS.

646. Scattering of α-Particles by A, O_2 and Ne. G. Brubaker. *Phys. Rev.* 54. *pp.* 1011–1017, *Dec.* 15, 1938.—Data on the scattering of α-particles by A, O_2 and Ne have been obtained with a novel experimental arrangement developed for the purpose. Anomalies were found in the scattering by all three elements. Irregularities in the course of the anomalies in the cases of O_2 and Ne have been interpreted as resonance phenomena. Estimates of the radii of the various nuclear barriers, based on the assumption that the penetrability of the barrier is appreciable at the lowest energy for which an anomaly is apparent, give the values $4{\cdot}5(10^{-13})$ cm. for O^{16}, $4{\cdot}6(10^{-13})$ cm. for Ne^{20}, and $7{\cdot}5(10^{-13})$ cm. for A^{40}. The first two are lower than values calculated from the formula $R = 2{\cdot}05(10^{-13})A^{\frac{1}{3}}$ and the last is somewhat higher. The latter result agrees with deductions of Pollard, Schultz and Brubaker from data on the A-α-*n* reaction [see Abstract 1572 (1938)]. AUTHOR.

647. Chemical Action of α-Particles on Aqueous Solutions. F. C. Lanning and S. C. Lind. *J. Phys. Chem.* 42. *pp.* 1229–1247, *Dec.*, 1938.—The action of α-particles from Rn was examined by two methods: (1) direct, the Rn being dissolved in the liquid acted upon, and (2) indirect, the Rn being contained in a thin-walled glass bulb and standardised by NH_3 decomposition. Dissolved in H_2O, HI and HBr are decomposed into H and I or Br; I forms HI; KI is not acted upon; and $KMnO_4$ (in N-H_2SO_4) gives $MnSO_4$. M/N (*i.e.* the number of molecules decomposed per ion-pair formed) was (by method I) for H_2O 0·739, HBr 1·187; (by method II) for H_2O 0·87, HI 1·86, $KMnO_4$ (0·0848-N) 0·576, (0·037-N) 0·893. It is inferred that the true value for H_2O is 1, and for HI 2, and that the primary effect is decomposition of H_2O into H_2O_2 and H_2, the other reactions being due to secondary effects. C. A. S.

648. Measurement of α- and β-Activities with a Selenium Cell. P. Bonet-Maury. *J. de Physique et le Radium,* 9. *pp.* 525–528, *Dec.,* 1938.—A sheet of ZnS crystals is attached to the glass cover of a Se cell and the arrangement is used to detect photoelectrically the impact of α- and β-particles on the crystal sheet. The sensitivity of the arrangement is greater with α- than with β-particles but the former gradually reduced the sensitivity of the ZnS screen. F. C. C.

649. Absorption Method for β-Rays of Great Energy. G. Guében. *Ann. Soc. Sci. de. Bruxelles,* 58. *pp.* 236–247, *Dec.* 12, 1938.—The methods of Feather [see Abstract 3758 (1930)] and Baschwitz [see Abstract 597 (1936)] for deducing the effective range of β-rays are compared and both shown to give satisfactory results. The ranges are determined for radio-Ir, -Au, -As and -P, and shown to conform to the equations $R = 0{\cdot}511E - 0{\cdot}091$, and $R^* = 0{\cdot}464E - 0{\cdot}102$, respectively. C. A. S.

650. Photographic Sensitometry for β-Ray Spectra. H. Brinkman, L. S. Ornstein and W. Langendijk. *K. Akad. Amsterdam, Proc.* 41. 10. *pp.* 1051–1054, 1938.—In a β-spectrum the electrons are shifted to lower energies by retardation in an electric field. From the comparison of the shifted and the unshifted spectrum on a photographic plate, the energetic sensitivity of the plate can be determined. AUTHORS.

***651. Conditions for Quantitative Operation of Geiger-Müller Counter for β-Rays. Ionising Power of β-Rays as a Function of Velocity. L. S. Ornstein, J. M. W. Milatz, H. ten Kate and M. Miesowicz.** *K. Akad. Amsterdam, Proc.* 41. 10. *pp.* 1055–1057, 1938.

***652. Portable Geiger Counter Unit. L. F. Curtiss.** *Bureau of Standards, J. of Research,* 21. *pp.* 779–782, *Dec.,* 1938.—A readily portable unit with entirely self-contained power supply, for operation of a l.v. Geiger-Müller tube counter is described. The Neher-Harper circuit is incorporated in an integrating circuit which yields one pulse for approximately 60 counter pulses. The output pulse operates a Cenco counter. The sensitivity is such that 1 microgram of Ra can be measured at 1 m. or 1 mg. at about 30 m. This unit can therefore be used for measuring the gamma-ray activity of feebly active samples and also to detect slight contamination due to spilled or broken Ra preparations. It also makes a very sensitive device for locating lost Ra. Since it is operated entirely from dry batteries mounted in the case it can be used anywhere. The total weight is 13 pounds. AUTHOR.

***653. Complete Geiger-Müller Counting System. H. Lifschutz.** *Rev. Sci. Instruments,* 10. *pp.* 21–26, *Jan.,* 1939.—Constructional details are given of a complete Geiger-Müller counting system consisting of a stabilised h.v. supply, Neher-Harper coupling circuit and vacuum-tube scale-of-eight feeding a Cenco counter stage. The system is entirely a.c. operated. Its resolution time of $6 \cdot 5 \times 10^{-6}$ sec. allows it to follow the G-M circuit without counting losses. The counting losses in the Cenco counter stage are negligible for random input rates to the system up to 20,000–30,000 counts a minute. AUTHOR.

***654. Internal Targets in Cyclotron. R. R. Wilson and M. D. Kamen.** *Phys. Rev.* 54. *pp.* 1031–1036, *Dec.* 15, 1938.—The large circulating ion current in the cyclotron which ordinarily does not reach the target chamber has been utilised in the preparation in high concentration of extremely active samples of radio-Fe and radio-P. By adapting as internal target the probes used in demonstrating the presence of the circulating current, it has been possible to enhance greatly the yields of radioactive materials as compared with those obtained in the usual manner at the target chamber. The construction of the probe, the nature of the circulating current and the manner in which the target material is applied to the probe are discussed. The general applications of the internal target technique are indicated. AUTHORS.

***655. Van de Graaff Generator for General Laboratory Use. J. G. Trump, F. H. Merrill and F. J. Safford.** *Rev. Sci. Instruments,* 9. *pp.* 398–403, *Dec.*, 1938.—An air-insulated d.c. electrostatic generator of the van de Graaff type, characterised by simplicity and low cost and suitable for a wide variety of research applications, is described. The generator, which employs re-entrant terminals, is capable of 500 kV and produces a short-circuit current of about 200 μA with a single 10″ belt. The manner in which the unit can be extended to higher voltages and currents is indicated, as well as the effect of operation in the presence of CCl_4 and CCl_2F_2 vapours. The operating principles, design considerations, theory of multiple belts, effect of humidity, problem of surge elimination, and cost are discussed. AUTHORS.

See also Abstracts **470, 472, 610, 662, 663, 677.**

RADIATION.

ABSORPTION.

656. Absorption of Aqueous Solutions at 4·72 μ. E. S. Barr and C. J. Craven. *J. Chem. Phys.* 7. *pp.* 8–10, *Jan.*, 1939.—By the use of a grating spectrometer, the infra-red absorption spectra of aqueous solutions of five inorganic materials (KI, $CuBr_2$, $ZnBr_2$, $CdCl_2 \cdot 2H_2O$ and NaOH) and six organic materials (acetone, CH_3COONa, CH_3COONH_4, cane sugar, C_6H_5OH and C_2H_5OH) were observed in the region of the water band at 4·72 μ. The organic materials investigated caused a displacement of the position of maximum absorption to shorter wave-lengths; the inorganic materials apparently caused a shift to longer wave-lengths, but the actual effect on the water band may be masked by other absorption bands in the same region. The concentration-shift relationship was investigated for some of the materials. Size of the solute molecule and the positive ion seemed to be of comparatively little importance. [See Abstract 2840 (1938).] AUTHORS.

657. Quantum Mechanics of Light Absorption of Hydrocarbons. T. Förster. *Zeits. f. techn. Physik,* 19. 12. *pp.* 611–614, 1938.—The u.v. absorption of the benzene series is examined on the basis of wave-mechanics. Good agreement is obtained with experiment on the assumption of a condensed ring system. F. C. C.

COLORIMETRY.

658. Selected Ordinates for Computing Trichromatic Coefficients and Candle-Power of a Light Source. F. T. Bowditch and M. R. Null. *J.O.S.A.* 28. *pp.* 500–501, *Dec.,* 1938.—To facilitate the calculation of the tri-stimulus values of a light source of known spectral energy distribution a table is given showing the wave-lengths at the mid-points of 30 equal sections of the areas under the curves showing the $\bar{x}$, $\bar{y}$ and $\bar{z}$ tri-stimulus values at all wave-lengths. To find the $\bar{x}$-coefficient for the source, the ordinates of the distribution curve are read at each of the 30 wave-lengths in the $\bar{x}$ column of the table and the sum of their ordinates is multiplied by a stated constant; similarly for the other two coefficients. It is pointed out that the method cannot be used for sources having a discontinuous spectrum. J. W. T. W.

See also Abstract 736.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

659. Electro-Optical Constants in Polar Liquids. N. Dallaporta. *N. Cimento,* 15. *pp.* 384–396, *June,* 1938.—Calculations are made of the electro-optical constants of a polar liquid on the basis of the following hypotheses: (1) the molecules are not able to revolve freely in the midst of the liquid but may possess privileged orientations for which are required forces which are functions solely of the angle of displacement; (2) the molecules are arranged in small groups of *quasi* crystalline structure. The formulæ obtained are compared with those of other authors, and the possibility of their application to the results of experiment is discussed. J. J. S.

660. Specific Magnetic Rotatory Powers of Ferric Nitrate and of a Sulphate of Cerium. H. Ollivier. *Comptes Rendus,* 207. *pp.* 983–985, *Nov.* 21, 1938.—The transparency and magnetic rotatory power of concentrated solutions of ferric nitrate in aqueous HNO_3 have been determined for two spectral regions, (i) 6540 ± 125 Å, and (ii) 5140 ± 150 Å. (i) corresponds with the principal maximum of transparency of the solutions examined, whilst (ii) corresponds with the middle of a secondary transparent zone. The magnetic rotations are positive but less than that of water. They are greater for (ii) than for (i) up to a maximum concentration, but thereafter the reverse holds. Calculations of G, the specific magnetic rotatory power [see Abstract 3043 (1937)], leads to a negative value. On increasing the temperature from 0° to 38°, $-1/G$ increases very slowly, then reaches a constant value. A yellow sulphate of cerium, which has the characteristics of a ceric salt, behaves as a cerous salt from the viewpoint of magnetic rotatory polarisation; it has a negative G, and $1/G$ varies considerably with temperature, in accord with the Weiss law. W. R. A.

EMISSION.

661. Possibility of Neutrino Theory of Light. A. Sokolow. *Physica,* 5. *pp.* 797–810, *Oct.,* 1938. *In German.*—The commutation laws for the neutrino waves and the relations between the neutrino field and the electromagnetic field are formulated in a new way, which, it is claimed, makes a consistent neutrino theory of light possible. R. P.

662. Nuclear Disintegrations by Cosmic Rays. W. Heitler. *Phys. Rev.* 54. *pp.* 873–876, *Dec.* 1, 1938.—Some rare instances of nuclear disintegrations by cosmic rays have in the past been observed in the Wilson cloud chamber. The determination of the possible mechanism of such a disintegration involves the question as to what is the process and its probability by which a cosmic-ray particle can transfer a large amount of energy to the nucleus or to one of the nuclear particles, and how the energy of the particle is distributed among the other nuclear particles. A detailed examination of these questions is presented. N. M. B.

663. Multiple Disintegration of Nuclei by Cosmic Rays: Results of 154 Cases in Photographic Emulsions. H. Wambacher. *Zeits. f. techn. Physik,* 19. 12. *pp.* 569–576, 1938.—Using the photographic emulsion method 154 multiple disintegrations of nuclei were found with the number of tracks varying from 3 to 14. Tracks were recorded from C, O, N, Br, Ag and S. There were 9 with more than 8 tracks; these were mainly from the heavier elements. By comparison with the tracks from 10 eMV protons liberated from paraffin by Be neutrons, some of the tracks were identified with fast protons. The energy distribution of the particles shows a steady increase to a lower limit of energy about 1 eMV. A distinct change in the energy distribution of the particles is observed with rising nuclear temperature. F. C. C.

664. Primary and Secondary Cosmic Rays, Showers and Bursts. W. M. Nielsen. *Frank. Inst., J.* 226. *pp.* 601–622; *Disc.,* 628–630, *Nov.,* 1938.—A large number of general features of cosmic-ray phenomena may be explained by supposing that a part of the radiation is made up of electrons and photons obeying the usual laws of radiation. Theoretical considerations indicated that the expected intensity of the radiation at sea-level is larger than would be predicted by this theory and have pointed to the existence of a more penetrating radiation. A number of workers have shown that there are ionising particles in cosmic radiation capable of pentrating 1 m. of Pb, whereas no electron of reasonable energy could penetrate more than 15 cm. At sea-level 25% of the particles are absorbed by 10 cm. of Pb; another metre reduces the number by another 30%. This group is called the penetrating component. The nature of this component is not entirely clear, and the present paper deals with the problem. Wilson suggested that the group consists of two components, heavy electrons and neutrinos. Late work makes it unnecessary to assume neutrinos to be present. Among other topics discussed are the variation of the hard and soft components, and shower and burst production. C. J. B. C.

665. Production of Showers by Cosmic Rays. C. G. Montgomery and D. D. Montgomery. *Frank. Inst., J.* 226. *pp.* 623–627, *Nov.,* 1938.—A number of investigators have measured the variation of shower production with atomic number and reported it to vary closely as Z^2. This was considered to offer confirmatory evidence for the cascade theory. There are deviations from the law, and where a Z^2 law has been reported, the phenomenon measured was primarily the result of an increase in size of the showers falling on the apparatus; when the "background" rate is reduced the ideal case is approached and the results conform more closely to Z^4. Evidence seems to show that there is no necessity to suppose any other mechanism than the ordinary multiplicative process to explain even the largest showers produced in thin material. Recent measurements do seem to point to the existence of a small number of showers which may arise from a different process. Experimental work along these lines is described. C. J. B. C.

666. Barometer Effect on Cosmic Rays. J. Zirkler. *Zeits. f. Physik*, 111. 3–4. *pp.* 183–185, 1938.—Results extending over the period Dec., 1936 to April, 1937, are analysed for a relation between the barometer effect and solar activity, with the help of a simple correlation calculation. G. O. B.

667. Production of Secondaries by the Soft and Penetrating Components of Cosmic Radiation. B. Trumpy. *Zeits. f. Physik*, 111. 5–6. *pp.* 338–344, 1938.—Photographs were taken with an automatic Wilson chamber which contained four lead plates of 0·3 cm. thickness each. By shielding the chamber with lead the effect of the penetrating component could be observed separately. The production of secondaries by the soft component agrees well with the theoretical values obtained by Bhabha and Heitler for electrons. The penetrating component produces in lead about 17% of secondaries, which, by using theoretical figures, indicates the mass of the particles forming this radiation to be somewhat greater than 100 electron masses. R. P.

668. Neutrons in Cosmic Radiation. E. Fünfer. *Zeits. f. Physik*, 111. 5–6. *pp.* 351–356, 1938.—Continuing earlier work in which the presence of neutrons in the atmosphere was demonstrated, it is shown that the number found is strongly influenced by neighbouring material. A large increase with increasing altitude (about eight times between 2650 m. and 160 m.) was found, and indicates the association of the neutrons with cosmic radiation. D. H. F.

669. Absorption of Penetrating Component of Cosmic Rays. W. Heisenberg. *Ann. d. Physik*, 33. 7. *pp.* 594–599, *Dec.*, 1938.—Allowing for the energy loss by ionisation, the absorption by nuclear collisions, and the spontaneous decay of the penetrating particles, the differential equation for the variation of their energy distribution with depth is constructed and its general solution obtained. The distribution is also studied on the assumption that in a certain energy range an additional process produces a very rapid loss of energy. R. P.

670. World-Wide Changes in Cosmic-Ray Intensity. S. E. Forbush. *Phys. Rev.* 54. *pp.* 975–988, *Dec.* 15, 1938.—Continuous cosmic-ray records for periods of 17 months or more obtained by Compton-Bennett meters at Cheltenham (United States), Teoloyucan (Mexico), Christchurch (New Zealand) and Huancayo (Peru) are reduced to a constant barometric pressure at each station. After deducting a 12-month wave from the data at each of these stations except at Huancayo, where none is found, a high correlation ($r \doteq 0\cdot 90$) is obtained between the means of cosmic-ray intensity for each one-third month for any two of the four stations. This high correlation, based on all available data for each pair of stations, is definite evidence that, except for the 12-month waves, the major changes in cosmic-ray intensity are world-wide. With published data from a Steinke instrument on the Hafelekar, near Innsbruck, the world-wide changes, when expressed in percent of the absolute intensity at each station, are found to increase rapidly with altitude for stations at the same latitude. A large increase in the world-wide effect for stations at high altitudes occurs between the equator and geomagnetic latitude 30° N,

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while no further very large increase occurs up to latitude 47° N. Results for Christchurch and Cheltenham indicate that the magnitude of the world-wide effect is symmetrical about the equator, and its connection with effects observed during certain magnetic storms is discussed. The amplitude of the 12-month wave, which in the Northern Hemisphere has its maximum near mid-January, increases from zero at the equator to about 1·0% at Teoloyucan, 1·6% at Cheltenham, and 1·9% on the Hafelekar. At Christchurch, its maximum occurs near the end of July, its amplitude being about 0·8% of the total intensity. Accordingly, it seems that the 12-month wave may not be ascribed to a solar-magnetic moment.

AUTHOR.

671. Cosmic-Ray Intensity and Geomagnetic Effects. T. H. Johnson. *Rev. Modern Physics*, 10. *pp*. 193–244, *Oct*., 1938.—This paper is a general survey of existing knowledge of the subject. A Bibliography of 276 references is included.

D. H. F.

672. Galactic Rotation and Intensity of Cosmic Radiation at Geomagnetic Equator. M. S. Vallarta, C. Graef and S. Kusaka. *Phys. Rev.* 55. *pp*. 1–5, *Jan*. 1, 1939.—The angle of deflection experienced by a primary cosmic particle moving in the plane of the geomagnetic equator is calculated for different energies and the result used to find the diurnal variation in the intensity of cosmic rays arriving vertically at the geomagnetic equator. If it is assumed that the number of primaries varies inversely as the cube of their energy, the calculation shows that there should be a diurnal variation in the vertical intensity of 0·17%, if all primaries are positive, with a maximum at 13 hr. 20 min. sidereal time. With a ratio of three positive to one negative primary, and the same distribution law, the amplitude of the diurnal variation should be 0·1% with a maximum at 12 hr. 30 min. sidereal time, while if the primary radiation as a whole is neutral (one positive particle to each negative) the amplitude should be 0·06% with maximum at 8 hr. 40 min. sidereal time. If the number of primaries is an exponentially decreasing function of their energy, the amplitude of the diurnal variation should be 0·24% with maximum at 18 hr. sidereal time, assuming all primaries are positive; if the primary radiation is neutral the amplitude should be 0·19% and the maximum should occur at 20 hr. 40 min. sidereal time. The expected diurnal variations for several values of the lower limiting energy are also discussed.

AUTHORS.

673. Nature of Penetrating Cosmic Rays. V. C. Wilson. *Phys. Rev.* 55. *pp*. 6–10, *Jan*. 1, 1939.—Geiger-Müller tube experiments have been performed to determine the nature of the cosmic rays present at depths of 30 and 300 m. water equivalent from the top of the atmosphere. At both of these depths, the observable cosmic rays are penetrating ionising rays accompanied by soft showers. The ratio of the soft showers to the penetrating rays increases with depth. [See Abstract 1597 (1938).]

AUTHOR.

674. Critical Analysis for Sidereal Time Variations of Cosmic Rays on the Pacific. J. L. Thompson. *Phys. Rev.* 55. *pp*. 11–15, *Jan*. 1, 1939.—The problem of distinguishing a true sidereal diurnal variation in cosmic-ray intensity from a seasonal change in the amplitude of the solar diurnal variation is approached from the standpoint of the harmonic dial type of analysis. It is shown that the regular cyclic arrangement of the datum points taken in chronological order serves as a criterion for the presence of the sidereal time variation. Cosmic-ray data taken on the

Pacific Ocean during 1936 by A. H. Compton and R. N. Turner are shown to contain no sidereal diurnal component larger than the experimental error. AUTHOR.

675. Penumbra of Cosmic Radiation. R. A. Hutner. *Phys. Rev.* 55. *pp.* 15–23, *Jan.* 1, 1939.—The development of the theory of the penumbra is given, and a few examples of penumbral trajectories are shown. Pairs of values of the energy and latitude having penumbral regions are indicated. Two methods of analysing the data obtained by means of Bush's differential analyser are given; the first yielding the allowed directions for just one type of penumbral orbit over all latitudes and for one energy; the second giving the whole penumbra for one energy and one latitude. The energy chosen in each case was $r = 0{\cdot}425$ störmer ($1{\cdot}08 \times 10^{10}$ eV for electrons). By means of the second method, the almost complete allowed cone is obtained for this energy and for a geomagnetic latitude of 20°. AUTHOR.

676. New Evidence for Existence of Penetrating Neutral Particles. F. R. Shonka. *Phys. Rev.* 55. *pp.* 24–27, *Jan.* 1, 1939.—An experiment of the Rossi-Hsiung type was performed at an altitude of 14,200 ft. with a fourfold coincidence array of Geiger-Müller tubes in a vertical position. Thicknesses of 12·7 to 17·3 cm. of lead served as absorber between the counters. Additional varying thicknesses were placed alternately above and between the counters, *i.e.*, in positions A and B. For small thicknesses the ratio of the counting rates with the lead in position A to that for position B was very little greater than unity. This means very slight production of barytrons by photons at this altitude. For greater thicknesses (19 to 23 cm.), however, the ratio A/B becomes $1{\cdot}06 \pm 0{\cdot}02$. Working at sea level, and having the bottom tube shielded with 25 mm. of lead, Hsiung obtained the same results. Maass, using no shield for the tubes, found the ratio A/B equal to 1·2. The most reasonable interpretation of the fact that this ratio is greater than unity seems to be the production of barytrons by non-ionising primaries. In view of the great thickness of lead required to give the maximum effect, these non-ionising particles must be much more penetrating than photons. This high penetrating power suggests their identification with the neutrettos (neutral particles having mass and other properties similar to the barytron) postulated by Heitler. AUTHOR.

See also Abstracts 751, 827, and
382B. Radiation and Cosmic Radiation. H. Thirring.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

677. Triboluminescence of Rock-Salt Irradiated with Radium. J. Trinks. *Akad. Wiss. Wien, Ber.* 147. 2a. 5–6. *pp.* 217–233, 1938.—The triboluminescence of NaCl and of KCl increases with the dosage, the thickness and the pressure. Crystals obtained from the molten salt glow more brightly than the natural substance. The triboluminescence is not a measure of the number of centres formed by irradiation since some of these emit only as thermoluminescence. The light sum emitted under pressure is only a small fraction of that given out under heating. J. E.

***678. Electrical and Luminescent Properties of Phosphors under Electron Bombardment. W. B. Nottingham.** *J. of Applied Physics*, 10. *pp.* 73–82, *Jan.*, 1939.—A tube using a kathode-ray type of electron gun has been used to study the properties of five phosphor samples using four different materials. These were (1) zinc-orthosilicate, (2) calcium-tungstate, (3) ZnS : CdS and (4) ZnS. The first three showed saturation effects with current density definitely greater than the last, and the first two have maximum potentials as limited by secondary emission of 6500 and 5000 V respectively. For these, the light output per unit electron current increased with the square of the voltage, while it increased with the 2·8 power of the voltage for the ZnS. A simple power law does not hold for the ZnS : CdS which shows a maximum light output at 8000 V. All of the sulphides had such good secondary emission properties that the maximum limiting potential was well above 10,000 V. [See also Abstract 166 (1938).] AUTHOR.

679. Luminescence. *Faraday Soc., Trans.* 35. *pp.* 1–240, *Jan.*, 1939.—A general Discussion of the subject comprising 29 contributions.

GENERAL INTRODUCTION.

" Recent Experiments in Luminescence," by **J. T. Randall** (*pp.* 2–14).—Deals mainly with the results of new experiments on the fluorescence of solids, particularly at low temperatures.

PART I. LUMINESCENCE OF LIQUIDS AND VAPOURS.

" Fluorescence in Solution," by **E. J. Bowen** (*pp.* 15–21).—Reviews the present position of this part of the subject.

" Relationship of Fluorescence to Photolysis in Gaseous Systems," by **R. G. W. Norrish** (*pp.* 21–28).—Puts forward the working hypothesis used by the author in photochemical work with polyatomic molecules.

" Fluorescence of Organic Compounds in Solution," by **P. Pringsheim** (*pp.* 28–33).—Discusses mainly the general conditions necessary in order that a compound may possess the power of fluorescence in the condensed state.

" Polarisation of the Fluorescence of Dyestuffs," by **H. Zocher** (*pp.* 34–39).—A description of an investigation into polarisation produced, not in the usual manner by asymmetric excitation in an isotropic solution, but by the parallel arrangement of molecules in anisotropic media.

" Photo-Luminescence and Vibrational Energy Exchange in Complex Molecules," by **A. Terenin, A. Vartanian and B. Neporent** (*pp.* 39–43).—A detailed examination of the photoluminescence of aniline vapour has been made and it is found that : (1) at low pressure and room temperature a " resonance " progression of sharp bands can be obtained, (2) admixture of certain gases up to 400 mm. pressure fails to affect the sharpness of the bands, (3) oxygen has a strong quenching action, (4) increase of temperature produces marked quenching.

" Quenching of Fluorescence in Solution," by **E. J. Bowen and A. Norton** (*pp.* 44–48).—The absolute fluorescence efficiencies of anthracene dissolved in a number of solvents under a variety of conditions of concentration, temperature, and in presence of various quenchers are measured, and the chief features of the results discussed.

" Photosensitised Reactions and the Quenching of Fluorescence in Solution," by **J. Weiss** (*pp.* 48–64).—Quenching of fluorescence in solution is discussed for those cases in which the elementary process of quenching is identical with the primary process of a photosensitised reaction. In these cases quenching is affected by a (radiationless) electron transfer in a complex between the excited molecule and the quenching acceptor molecule—this reaction (in general reversible in the dark) is studied for various dyes.

In the presence of molecular oxygen photosensitised oxidation is obtained. Oxygen may also exert a direct quenching effect on certain dyes.

PART II. LUMINESCENCE IN SOLIDS.

Introductory Paper, by **F. H. Spedding** (*pp*. 65–69).—Luminescence is discussed here mainly from the point of view of the absorption spectra of solids (at low temperatures) since these may be regarded as complementary to their phosphorescent and fluorescent spectra.

" Luminescence in Solids," by **R. W. Gurney and N. F. Mott** (*pp*. 69–73).—This paper deals with certain theoretical aspects of the subject.

" Interpretation of Crystal Luminescence," by **F. Seitz** (*pp*. 74–100).—A theoretical discussion of the mechanism which may be used for describing crystal luminescence for the two classes typified by sodium chloride containing thallium and zinc sulphide containing copper.

" Sulphide Phosphors and the Zone Theory of Solids," by **C. J. Milner** (*pp*. 101–114).—This paper describes a general and qualitative application of the modern quantum or " zone " theory to the properties of sulphide and allied phosphors, with the aim of setting up a working hypothesis for this field.

" Phosphorescent Glasses. Decay of Phosphorescence," by **M. Curie** (*pp*. 114–118).—This paper discusses the influence of crystallisation upon the intensity and duration of luminescence in zinc borate, and ordinary, glass, both vitreous and crystalline ; the decay of the green and orange luminescence of crystallised zinc borate ; mechanisms.

" Luminescence of Inorganic Solids," by **J. Ewles** (*pp*. 119–127).—Known examples of luminescent inorganic salts are first surveyed. Details are then given of an investigation into the resolution of luminescent spectra at low temperatures. Finally, tentative suggestions are made towards explaining the phenomena.

" Differential Action of Ni, Fe and Co upon the Fluorescence and Phosphorescence of ZnS Phosphors Excited by X-Rays," by **L. Levy and D. W. West** (*pp*. 128–134).—It is found that the addition of small quantities $(\sim 1/2 \times 10^6)$ of Ni, Co or Fe to ZnS phosphors reduces the total phosphorescence and fluorescence due to X-rays. The effect varies with the substance, and with the amount, added ; whilst the two effects (fluorescence and phosphorescence) do not vary in the same manner as the conditions are changed.

" New Results with Luminescent ZnS," by **N. Riehl** (*pp*. 135–147).—Collects up the experimental and theoretical results obtained by the author during recent years on ZnS.

" Application of Phosphorescence Spectra to the Investigation of the Structure of Solids and Solutions," by **R. Tomaschek** (*pp*. 148–154).—The application of absorption and luminescence spectra to the investigation of the energy states in the interior of solids and liquids is considered in this work and it is pointed out that information is obtainable concerning the electric forces on the atom within the bodies.

" Ratio of Primary to Secondary Light Emitted in Fluorescent Discharge Tubes Containing Neon," by **H. G. Jenkins and J. N. Bowtell** (*pp*. 154–163).—The primary object in the work described here was the determination of the conditions of current density, pressure, etc., for operating neon luminescent tubes to obtain the optimum resultant colour, luminous output, efficiency and life.

"Luminescence of Oxides under Flame Excitation," by **L. T. Minchin** (*pp.* 163–171).—A summary of existing knowledge.

"Practical Applications of Luminescent Solids," by **L. J. Davies** (*pp.* 171–177).—A summary of the main points that concern the industrial research worker in connection with luminescent solids.

PART III. CHEMILUMINESCENCE.

"Luminescence of Sodium Vapour in Highly Dilute Flames," by **M. G. Evans and M. Polanyi** (*pp.* 178–185).—In this paper is set out an attempt to elucidate how the experimental facts may be accounted for by the atomic mechanism of the reactions in question.

"Chemiluminescence of Sodium Vapour with Organic Halides," by **C. E. H. Bawn and W. J. Dunning** (*pp.* 185–197).—Experiments are described in which sodium vapour interacts with various organic halides. It is found that all the saturated organic dihalides exhibit the same characteristic luminescence (intense D line radiation). The various reactions are discussed in detail.

"Emission of U.V. Rays by Chemical Reactions," by **R. Audubert** (*pp.* 197–206).—A review is given of the principal phenomena so far investigated by this method.

"Chemiluminescence in the Oxidation of Certain Organic Substances," by **H. D. K. Drew** (*pp.* 207–216).—A review of some of the hypotheses put forward to account for the luminescence of organic substances in solution on oxidation.

"Quenching of Luminescence by Oxygen," by **H. Kautsky** (*pp.* 216–219).—An attempt to clear up two general questions: (1) What process underlies the quenching of fluorescence by oxygen? (2) Is this process connected with photo-oxidation sensitised by fluorescent dyes?

"Oxidation and Chemiluminescence," by **J. Weiss** (*pp.* 219–226).—A general survey and discussion of the subject.

"Electro-Photoluminescence," by **G. Destriau** (*pp.* 227–233).—Surveys the various luminous phenomena brought about by powerful electric fields in photoluminescent bodies.

"Bioluminescence," by **E. N. Harvey** (*pp.* 233–235).—A survey article.

The whole proceedings are summarised briefly by **P. Pringsheim** (*pp.* 235–238). A. H.

See also Abstracts 684, 715.

INTERFERENCE, DIFFRACTION AND SCATTERING.

680. Intensity Distribution in Rayleigh Lines in Light Scattered by CS_2, $CHCl_3$ and CCl_4. J. Pniewski. *Acta Physica Polonica*, 7. 2. *pp.* 186–194, 1938. *In German.*—The scattered light spectra of liquid CS_2, $CHCl_3$ and CCl_4 are analysed under high dispersion on the basis of the rotation theory of the diffuse Rayleigh lines. It is found that the intensity distribution in the parts of the "wings" lying very close to the lines is not in agreement with this theory. It is therefore doubtful whether molecular rotation plays the chief part in the origin either of outer or of inner parts of the wings. C. B. A.

See also Abstracts 620, 690.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

681. Photochemical Oxidation of Acetone. F. O. Rice and C. E. Schildknecht. *Am. Chem. Soc., J.* 60. *pp.* 3044–3047, *Dec.*, 1938.—The products of the photochemical oxidation of gaseous acetone at 100° with the full radiation from a mercury vapour lamp are acetic acid and formaldehyde; the formaldehyde is largely oxidised to CO_2 and water; there are smaller amounts of organic peroxides formed. The quantum yield of the oxidation process has been found to be about 0·3, approximately ten times the quantum yield of the photochemical decomposition in presence of CO_2 in the same system. AUTHORS.

682. Photochemical Addition of Br_2 to C_6H_5Br in CCl_4 Solution. D. L. Hammick, J. M. Hutson, and G. I. Jenkins. *Chem. Soc., J. pp.* 1959–1964, *Dec.*, 1938.—It is shown that there is no thermal reaction at ordinary temperatures between Br_2 and C_6H_5Br in CCl_4 solution. When, however, the system is irradiated with light of wave-length 4360 Å, addition of Br_2 takes place by a comparatively simple mechanism. The photo-addition is of low quantum efficiency (0·01–0·005), is unaffected by the presence or absence of O_2, and is uncomplicated by substitution. AUTHORS.

683. Photolysis of β-Chloro-β-Nitrosobutane. S. Mitchell and J. Cameron. *Chem. Soc., J. pp.* 1964–1968, *Dec.*, 1938.—This paper describes the technique developed by the authors for measuring quantum efficiencies with red light. The value 1·2 has been obtained for the photolysis of β-chloro-β-nitrosobutane in methyl alcohol. The products, hydrogen chloride, methyl ethyl ketoxime, and the monoxime of diacetyl, have been isolated and the reaction mechanism is discussed. AUTHORS.

684. Blackening of ZnS Phosphors. N. T. Gordon, F. Seitz and F. Quinlan. *J. Chem. Phys.* 7. *pp.* 4–7, *Jan.*, 1939.—The process of blackening of ZnS and CdS phosphors is studied experimentally and theoretically. A survey of the principal experimental facts is given and several new experiments are described. It is suggested that the blackening of the sulphide salts is a two-quantum process in which both positive and negative charges are released from the interior; these charges move to the surface and there produce electrolysis in a film of moisture that is present on the surface when the specimen is in damp air. This picture will explain the known experimental facts concerning the blackening process. The important differences between the blackening of sulphides and the print-out effect in photographic emulsions are discussed. AUTHORS.

685. Fine Grain Photographic Development. G. Higgins. *J. of Applied Physics*, 10. *pp.* 18–26, *Jan.*, 1939.—The effect of different fine grain photographic developers upon the effective emulsion speed and graininess of photographic materials was studied quantitatively. Fine grain developers were found to be more effective in reducing the graininess of fast, coarse grain emulsions than of slow, fine grain emulsions. The effective emulsion speed of slow, fine grain emulsions when developed in an MQ borax developer was found to be at least equal to that of a fast, coarse grain emulsion when developed in an ultra-fine grain developer which gave negatives of as low graininess on the fast emulsion as the MQ borax gave on the slow emulsion. Slight improvement in graininess can be obtained by using ultra-fine grain developers on fine grain emulsions, but only at some sacrifice of effective emulsion speed. AUTHOR.

686. Mechanism of Photographic Reversal. Part II. Albert Effect. G. W. W. Stevens. *Phot. J.* 79. *pp.* 27–43; *Disc.*, 43, *Jan.*, 1939.—The paper describes an experimental investigation of the Albert reversal, from which the following conclusions were drawn. (1) The chromic acid treatment produces an even desensitisation all over the film, and superimposed on this there is a further desensitisation produced by a preliminary exposure. (2) The ripening state of the film, with respect to surface sensitivity centres, has practically no influence on the production of the reversal. (3) Both a qualitative and a quantitative correlation is found between the behaviour of the residual latent image, which survives the chromic acid treatment, and the Albert reversal. This agreement is so marked that the residual latent image was considered to be the cause of the reversal. (4) The characteristics of this image suggest that it actually exists inside the AgBr grains, and this was finally confirmed by a modified repetition of Kempf's recent experiment. (5) Both the production of the reversal and of the residual latent image shows a marked reciprocity failure with respect to the first exposure. These effects were favoured by the higher intensities, in an intensity region at, or above, the optimum intensity for the films used. It was suggested that this last result might have some connection with the Dember effect. The general significance of the experiments for the theory of photographic sensitivity, and the connection between the Albert and Clayden effects, and possibly solarisation, have also been discussed. [For Part I see Abstract 3689 (1938).] AUTHOR.

687. Photographic Masking Methods of Colour Correction for Three- and Four-Colour Printing. F. J. Tritton. *Phot. J.* 78. *pp.* 732–738, *Dec.*, 1938.—Summarises the previously published data on this subject, most of which is to be found in patent specifications, wherein the subject matter is expressed in widely differing terms. It has, therefore, been necessary to modify the subject matter so that the various patents can be compared, this being done by means of a tabular method. The various processes dealt with are those in which black is eliminated from all colours, those in which black is not eliminated from the colour plates, those for which detailed instructions have been published, and miscellaneous processes. There is also a short paragraph dealing with registration devices. R. C. F.

***688. Photoelectric Exposure Meters. E. Nähring.** *Phot. Indust.* 36. *pp.* 1358–1362, *Dec.* 7, *and pp.* 1384–1386, *Dec.* 14, 1938.—This paper is based on a survey of the patent literature relating to photoelectric exposure meters for photographic purposes, and gives details of the many types that have been introduced or proposed. D. H. F.

See also Abstracts 525, 585, 650.

PHOTOMETRY.

***689. Replacement of Optical by Electrical Intensity-Reducing Devices in Photoelectric Photometry. E. J. Meyer.** *Zeits. f. Astrophysik*, 16. 5. *pp.* 367–373, 1938.—The essential problem of photoelectric photometry is to arrange that light from each of two sources of different intensity shall produce the same deflection of an electrometer in a given time. Normally this is achieved by the use of a calibrated intensity-reducing device in the path of the more intense light, *e.g.*, a Pt wedge or an objective diaphragm. Two alternative methods, which are free from some of the objections raised against intensity reduction, are investigated, *viz.*, the increase of electrometer sensitivity and electrometer capacity when measuring the fainter source to give the same deflection as the intenser source. Both methods are found to give satisfactory, reliable results. J. E. K.

See also Abstracts 658, 688.

POLARISATION.

See Abstracts 722, 729.

REFLECTION, REFRACTION AND DISPERSION.

690. Image Production in the Microscope. H. Boersch. *Zeits. f. techn. Physik*, 19. 11. *pp*. 337–338, 1938. *Phys. Zeits.* 39. *pp*. 933–936, *Dec*. 15, 1938.—With the portrayal of gratings in the microscope there arises in the posterior focal plane of the objective the Fraunhofer diffraction figure of the grating. A method is described of producing on this plane artificially the light distribution of the diffraction figure of a grating and thereby imitating the picture of this grating although on the object plate no grating exists. Possible application of this arrangement to the estimation of X-ray and electron-interference pictures of crystals is suggested. J. J. S.

691. Method of Parallax and Resolving Power of the Eye. S. B. Mathur. *Phil. Mag.* 27. *pp*. 94–97, *Jan*., 1939.—The paper describes some observations made to determine the accuracy obtainable in ordinary laboratory experiments on the method of parallax and its relation with the resolving power of the eye. AUTHOR.

692. Refractive Indices of Resins and Plastics. C. D. West. *Indust. and Engin. Chem.* (*Analytical Edition*), 10. *pp*. 627–628, *Nov*. 15, 1938.—Notes on the technique of measuring with an Abbé refractometer the refractive indices of resins and plastics, including those that soften above 70° C. W. S. S.

***693. U.V. Refractive Indices. A. Goldet.** *Comptes Rendus*, 207. *pp*. 1040–1041, *Nov*. 28, 1938.—The refractometer used is a modification of that of Terquem and Tramin [*Comptes Rendus*, 78. *p*. 1843, 1874] with the monochromatic source of light replaced by a hydrogen lamp, and the glass discs by quartz. The method of observation, depending on total reflection, is described in some detail. C. A. S.

694. Refraction and Dispersion of HCl, HBr, H_2S, DCl, DBr and D_2S. T. Larsén. *Zeits. f. Physik*, 111. 5–6. *pp*. 391–398, 1938.—The dispersion of HCl, HBr, H_2S, DCl, DBr, and D_2S has been investigated from the visible into the u.v. For HCl the investigation was carried to 2302 Å, for HBr to 2447 Å, and for H_2S to 2346 Å. Two-membered formulæ expressing the variation of dispersion with wave-length in the absorptionless region are given for the light gases, and the ratio of the refraction of the light and heavy compounds is calculated at different wave-lengths. The heavy molecules show a similar isotope effect to that previously found for D_2 and CD_4, *i.e.*, a decrease in the absolute value of the refraction and smoother dispersion curves. The dispersion curve rises anomalously within the range over which absorption occurs. A. J. M.

695. Relation of Refractive Index to Density in Dental Hard Tissues. R. S. Manly. *Am. Chem. Soc., J.* 60. *pp*. 2884–2886, *Dec*., 1938.—The mean refractive indices of powdered enamel and dentine samples, with differing and known density limits, were determined by the Becke line procedure. The refractive indices of dried enamel lie between

1·612 and 1·630 and are proportional to the density. The refractive indices of dried dentine lie between 1·555 and 1·530 and are roughly proportional to the density when the fractions are dried under the same conditions for both determinations. Vacuum drying brought about a marked lowering of refractive index. Secondary cementum exhibited a refractive index of 1·560–1·570 which was little affected by vacuum drying. AUTHOR.

***696. Construction Principles of Precision Refractometers. R. Landwehr.** *Zeits. f. techn. Physik,* 19. 11. *pp.* 336–337, 1938.—A discussion is given as to what conditions a refractometer with grazing ingress (Pulfrich) must satisfy with respect to construction, possibilities of adjustment of the particular parts, as well as form of the prism, in order that a higher accuracy (5th decimal figure of the refractive index) can be attained than with the appliances of the hitherto usual arrangement. J. J. S.

***697. Apparatus for Determining Focal Lengths of Lenses of Long Focus and Small Aperture. R. Pelz.** *Zeits. f. Instrumentenk.* 58. *pp.* 495–499, *Dec.,* 1938.

See also Abstract 763.

SPECTROSCOPY.

698. First Spark Spectrum of Platinum. A. G. Shenstone. *Roy. Soc., Phil. Trans.* 237*A*. *pp.* 453–470, *Nov.* 9, 1938.—The paper reports observations on the spectrum Pt II and classifies a large number of levels. A list of lines is also given including : (i) All identified lines between λ976 and λ1242. (ii) All certain low-transition lines and all identified high-transition lines between λ1242 and λ4514. AUTHOR.

699. Far U.V. Spectrum of Rb. R. Ricard and F. Valancogne. *Comptes Rendus,* 207. *pp.* 1093–1094, *Dec.* 5, 1938.—The wave-lengths and relative intensities of 92 lines between 2000 and 1050 Å are recorded. W. R. A.

700. Prolongation of 1^1P_1–m^1S_0 Series of Zn. H. Bruck. *Comptes Rendus,* 207. *pp.* 1194–1195, *Dec.* 12, 1938.—Using an atomic jet of Zn the series has been extended to include three more lines. W. R. A.

701. Optical L-Spectra of Elements Cr to Co in Extreme U.V. F. Tyrén. *Zeits. f. Physik,* 111. 5–6. *pp.* 314–317, 1938.—The L-spectra between 22 and 12 Å are recorded for Cr(24), Mn(25), Fe(26) and Co(27). 34 lines are identified in all, the shortest wave-length measured being 12·1 Å for Fe XVII. An ionisation potential of about 1400 V is calculated for Co XVIII. C. B. A.

702. Influence of Foreign Gases on Absorption of Hg Line 4078 Å by Se Vapour. T. Skaliński. *Acta Physica Polonica,* 7. 2. *pp.* 177–194, 1938. *In German.*—The effect of N_2 on the absorption by Se vapour of several of the rotation lines covered by the broadened Hg line 4078 Å is investigated with the help of a Lummer-Gehrcke plate. The addition of N_2 up to a pressure of 33·5 mm. causes an increase of the absorption. This is an indirect confirmation that the quenching of the fluorescence is associated with predissociation. C. B. A.

703. Absolute Intensity of Zinc Resonance Line, 2138·6 Å. Line Form and Vapour Pressure of Zinc. J. Ausländer. *Helv. Phys. Acta,* 11. 7. *pp.* 562–586, 1938. *In German.*—The hyperfine structure of the Zn $4^1S_0 - 4^1P_1$ resonance line, 2138·6 Å, has been investigated by the absorption method. The line possesses only one maximum and characteristics of the line form are given. The resonance light emitted perpendicular to the exciting primary beam is completely depolarised. The absolute intensity of the line and the vapour pressure of zinc have been determined. W. R. A.

704. Wave-Mechanical Treatment of Line Broadening. Part II. A. Jabłoński. *Acta Physica Polonica*, 7. 2. *pp.* 196–206, 1938. *In German.*—It is shown that the limiting forms of line broadening can be predicted wave-mechanically. The dispersion form (but without a damping constant) is obtained with sufficiently small differences between the two combining potential curves and when the collision partners do not have too small a velocity. The line-width is proportional to the pressure but does not depend directly on the number of collisions. A condition is deduced which limits the application of the frequency distribution as a line form: it is almost identical with the Kuhn-London condition. [For Part I see Abstract 3243 (1938).] C. B. A.

705. Connection Between Increase and Decrease in Intensity of Spectral Series by Electric Fields. R. Ritschl and R. Siksna. *Phys. Zeits.* 39. *pp.* 767–772, *Nov.* 15, 1938. *From the Reichsanstalt.*—Measurements are made of the variations with increasing electric field strengths up to 1875 kV/cm. of two pairs of the He lines, $2s$–$4p$, $2p$–$4p$ and $2s$–$5p$, $2p$–$5p$ each pair comprising an allowed transition and a forbidden transition with common upper levels. The forbidden lines increase in intensity with increase of field up to a certain strength at the expense of the ordinary lines which exhibit the previously observed decrease with increase of field. The line $2p$–$5p$ passes through an intensity maximum at 145 kV/cm. and $2p$–$4p$ shows evidence of passing through a maximum about 175 kV/cm.; the decreases of intensity above these field strengths may be connected with the appearance of new forbidden lines from the same upper level. The lines $2s$–$4p$ and $2p$–$4s$ show a gradual decrease of intensity with increase of field over the range applied. J. E. K.

706. Pressure Shifts of High Terms of Absorption Series of Na, Rb and Cs Produced by H_2 and N_2. Ny Tsi-Zé and Ch'en Shang-Yi. *Phys. Rev.* 54. *pp.* 1045–1047, *Dec.* 15, 1938.—The pressure shifts of the high terms of the principal series of Na, Rb and Cs produced by commercially pure H_2 and N_2 were studied. Measurements were made for different concentrations of the perturbing gases up to a pressure of about 12 atm. (617° K.) for H_2 and 7·5 atm. (548° K.) for N_2. The former produced a strong and the latter a very slight violet shift and the effective cross-sections as calculated by Fermi's equations were found to be 14·0 $cm^2./cm^3.$, and 2·0 $cm^2./cm^3.$ respectively. For axially symmetrical molecules the values of effective cross-sections calculated from Fermi-Reinsberg equations do not agree with those obtained by a direct electrical method. [See Abstract 2097 (1937).] AUTHORS.

707. Hyperfine Structure and Analysis of Complex Lines in U.V. As II Spectrum. S. K. Mukerji. *Indian Journ. Phys.* 12. *pp.* 331–340, *Nov.*, 1938.—All the important lines in the region λλ3200–2400 of the first spark spectrum of As emitted by a water-cooled hollow kathode discharge have been investigated, with a quartz Lummer plate, for hyperfine structure. An attempt has been made to analyse the incompletely resolved and complex lines, assuming the nuclear spin of As to be 3/2 as previously determined. An estimate has also been made of the values of the fine-structure intervals and the term interval factors of the lines investigated. One of the unclassified lines has shown an inverted structure. Fine structure perturbation effect is suspected in one of the partially classified lines. AUTHOR.

708. Mechanical Moments of ^{171,173}Yb, Quadrupole Moment of ^{173}Yb and Abundance Ratio of ^{173}Yb/^{171}Yb. H. Schüler, J. Roig and H. Korsching. *Zeits. f. Physik*, 111. 3–4. *pp.* 165–173, 1938.—From analysis of the hyperfine structures of the three YbI lines 6489, 6799 and 7699 Å—$[(6s7s)^3S_1 - (6s6p)^3P_{0,1,2}]$—it is deduced that the mechanical moments of the ^{171}Yb and ^{173}Yb nuclei are $i = \frac{1}{2}$ and $\frac{5}{2}$ respectively. The terms of ^{173}Yb are inverted and its quadrupole moment is $q = + 3{\cdot}9 \times 10^{-24}$ cm^2., this value is the second largest yet determined. The abundance ratio of the isotopes ^{173}Yb/^{171}Yb is found to be 1·14 from measurement of the component line intensities; this compares with the value 1·89 given as a rough estimate by Aston. From comparison of all quadrupole moments hitherto determined some broad conclusions are drawn concerning the causes of unsymmetrical charge distribution in the nucleus. [See following Abstract.] J. E. K.

709. Magnetic Moments of ^{171,173}Yb and Isotope Shifting in Yb I. H. Schüler and H. Korsching. *Zeits. f. Physik*, 111. 5–6. *pp.* 386–390, 1938.—On the basis of spectroscopic observations on hyperfine structure the magnetic moments of ^{171}Yb at $\mu = 0{\cdot}4_5$ and of ^{173}Yb at $\mu = -0{\cdot}6_5$ were determined. The ratio of the magnetic moments μ_{173}/μ_{171} is 1·4. Some considerations on the deviations of the magnetic moments of the atomic nucleus from the single particle model are discussed. From λ 5556 there appears for the 6 S^2 configuration an isotope shift of about 30×10^3 cm^{-1}. [See preceding Abstract.] J. J. S.

710. Influence of Nuclear Electric Quadripole Moment on Paschen-Back Effect of Hyperfine Structure and Structure of Hg Line 2537 Å. T. Schmidt. *Zeits. f. Physik*, 111. 5–6. *pp.* 332–337, 1938.—Formulæ for the effect of the nuclear quadripole moment on the Paschen-Back effect of hyperfine structure are derived and applied to the case of the Hg line 2537 Å. The agreement with the observed structures is thereby considerably improved. R. P.

711. Calculation of Position and Width of Energy Bands of Valence Electrons in Alkali Metals. P. Gombás. *Zeits. f. Physik*, 111. 3–4. *pp.* 195–207, 1938.—A new analytical method for the calculation of the position and width of the energy bands of valence electrons, based on the Ritz approximation process, has been mathematically developed and is applied to the study of the alkali metals. W. R. A.

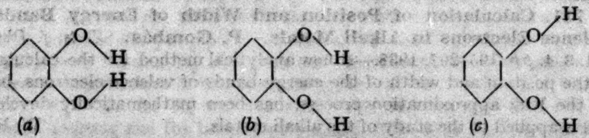
712. Far Infra-Red Spectra of Methane Derivatives. M. Parodi. *Comptes Rendus*, 207. *pp.* 1196–1197, *Dec.* 12, 1938.—The transmissions of CH_2Cl_2, CH_2Br_2, CH_2I_2, $CHCl_3$, $CHBr_3$, CCl_4, and CBr_4 in the region 17 to 65 μ have been measured. Wave-lengths of bands are given and some are assigned as fundamentals or overtones. Others are possibly combination tones. W. R. A.

713. Rotational Analysis of First Negative Band Spectrum of Oxygen. T. E. Nevin. *Roy. Soc., Phil. Trans.* 237*A*. *pp.* 471–507, *Nov.* 23, 1938.—The (1, 0), (0, 0) and (0, 1) bands of the first negative system of O_2^+ have been photographed in the second order of a 21-ft. grating. Each of the bands has been analysed into forty branches, the transition involved being $^4\Sigma \rightarrow {}^4\Pi$. The fine structure of the $^4\Sigma$ level agrees with the theoretical structure predicted by Budó [see Abstract 2649 (1937)]. The $^4\Pi$ level is inverted. The structure of the level does not agree with that to be expected on theoretical grounds from formulæ given by Brandt and Budó. It is suggested that this disagreement is caused by a perturbation similar to that observed by Bulthuis and Coster in the $A^2\Pi$ level of CO^+. The constants of O_2^+ in the $^4\Sigma$ and $^4\Pi$ states are tabulated. AUTHOR.

714. Structure and Absorption Spectra of Diamino Dyes Derived from Acridine. P. Ramart, M. Grumez and M. Martynoff. *Comptes Rendus,* 207. *pp.* 1105–1109, *Dec.* 5, 1938.—Absorption spectra are recorded for acridine yellow, acridine orange, benzoflavine, and tetramethylflaveosine in neutral and alkaline solutions. They indicate that these substances can exist in solution in two forms, of ortho- or para-quinonoid types respectively, which are reversibly interconvertible. C. B. A.

715. Absorption Spectra and Fluorescence of Heterocyclic Compounds. O. V. Fialkovskaja. *Acta Physicochimica,* 9. 2. *pp.* 215–234, 1938. *In English.*—The absorption spectra and the fluorescence of heterocyclic compounds of pyridine, indol, furane, thiophene, chinolin and pyrrol in their vaporous state have been examined in a small interval of pressures, from about 10^{-3} mm. Hg and upwards. The first four substances exhibited characteristic absorption band spectra. The absorption spectrum of chinolin is somewhat more diffuse. Fluorescence has been detected only in indol and chinolin and represents a wide spectral region with marginal diffusion. AUTHOR.

716. Infra-Red Absorption of Phenolic Compounds. M. M. Davies. *Faraday Soc., Trans.* 34. *pp.* 1427–1429, *Dec.,* 1938.—The suggestion by Pauling [see Abstract 1204 (1936)] that the data of Wulf and Liddel [see Abstract 4267 (1935)] on the first overtone of the fundamental of OH can be interpreted by the assumption that the OH group has either a *cis-* or *trans-*orientation with respect to an adjacent *ortho* group has been tested by examining *o*-chlorophenol at 18° and 73° and at the higher temperature two components are clearly resolved. From the corresponding integrated absorptions $E = 1420$ cal./mol. at 73°. Catechol possesses the three structures


(*a*) (*b*) (*c*)

and the predicted great preponderance of (*b*) is reflected by the appearance of two absorption maxima of practically equal intensity arising from the *cis-* and *trans-*OH groups. W. R. A.

717. Spectrum of Lead Hydride. W. W. Watson. *Phys. Rev.* 54. *pp.* 1068–1071, *Dec.* 15, 1938.—From a lead arc in a H_2 atmosphere at four to five atm. pressure, a "many-lined" spectrum in the region 5000–7000 Å due to PbH has been produced. Practically all of the lines have been assigned to ten bands constituting a $^2\Sigma \rightarrow {}^2\Sigma$ transition between an upper state of low stability and a stable ground state ($\omega_e = 1565\cdot2$, $B_e = 4\cdot972$). Strong interaction with other states is evidenced by a very large spin-doubling ($\gamma = 6\cdot17$) in the lower state and in the upper state by an unorthodox variation of B_v' with v, irregular spin doubling, a prominent failure of the Mecke rule and a sharp cut-off of levels at about $\frac{1}{3}$ volt above $K' = 0$, $v' = 0$. AUTHOR.

718. Rotational Structure of $^3\Sigma \rightarrow {}^3\Pi$ Bands of BF. F. W. Paul and H. P. Knauss. *Phys. Rev.* 54. *pp.* 1072–1077, *Dec.* 15, 1938.—The rotational analysis has been made of the (0, 0), (0, 1), (0, 2) and (1, 0) bands of the *A* system of BF. The bands are interpreted in terms of a $^3\Sigma \rightarrow {}^3\Pi$ transition with coupling intermediate between case *a* and case *b*. The triplet separation of the upper ($^3\Sigma$) state is too small to be observed; that of the lower ($^3\Pi$) state is $-12 \cdot 7\ B''$. The Λ-type splitting of the $^3\Pi$ states is less than $0 \cdot 2$ cm^{-1}. Other constants evaluated are $B'_0 = 1 \cdot 6235$, $B'_1 = 1 \cdot 6030$, $D'_0 = -4 \cdot 2 \times 10^{-6}$, $D'_1 = -9 \cdot 7 \times 10^{-6}$, $B''_0 = 1 \cdot 4030$, $B''_1 = 1 \cdot 3851$, B''_2 $1 \cdot 3672$, all in cm^{-1}. units; $I'_e = 16 \cdot 93 \times 10^{-40}$ gm. cm^2., $I''_e = 19 \cdot 56 \times 10^{-40}$ gm. cm^2., and $r''_e = 1 \cdot 312 \times 10^{-8}$ cm.
AUTHORS.

719. Predissociation in Diatomic Molecular Spectra. B. Grundström. *Zeits. f. Physik*, 111. 1–2. *pp.* 55–60, 1938.—The complicated nature of the predissociation which takes place in the C-term of BaH has led the author to assume three special cases of predissociation, *viz.*: (1) The J quantum number of, and the energy of, the highest stable level, get smaller and smaller as the *v* quantum number increases; (ii) All rotation levels with $v=0$ are less stable than those with higher *v* values. (iii) The J number and the energy of the lowest stable level get greater as *v* increases. The properties of the potential curves are discussed for these three cases. In a second part is discussed the intensity of the predissociated lines, and an example is given of a portion of a CaH band, where several lines have abnormally low intensity, ascribed to predissociation.
A. C. M.

720. Continuous Spectrum of High-Pressure Hg Lamp and Similar Gas Discharges. A. Unsöld. *Ann. d. Physik*, 33. 7. *pp.* 607–616, *Dec.*, 1938.—The theory of gas discharge is discussed and the results compared with the observations on the high-pressure Hg lamp by Elenbaas and on the under-water spark by Wyneken.
F. S.

721. Absorption Bands of Divalent Rare-Earth Ions and Calcium in Fluorite and other Substances and their Interchange Effects. K. Przibram. *Akad. Wiss. Wien, Ber.* 147. 2*a*. 5–6. *pp.* 261–270, 1938.—The maximum in the absorption spectrum of different fluorites at 3500–3900 Å has been allocated to divalent Eu, that at 4300–4700 Å to divalent Sm, and the long-wave maximum at about 5200 Å to Ca atoms in a colloidal complex. The yellow colour of fluorites is thus attributed to rare-earth ions and the blue colour to reduced Ca while the green colour is considered as due to the joint effect of rare earths and Ca absorption. Electron exchange between Ca ions and rare earth ion in Eu-activated $CaCl_2$ is considered as playing an important part in the colour alteration and fluorescence of fluorites and in other minerals.
J. E.

722. Effect of Canal-Ray Impacts on Polarisation of Spectral Lines in a Magnetic Field. J. Stark and H. Verleger. *Phys. Zeits.* 39. *pp.* 763–767, *Nov.* 15, 1938. *From the Reichsanstalt.*—The observations which relate to intensities of Hα, Hβ, Hγ excited by H canal-ray collisions with the molecules and to 6 He lines excited by He canal-ray collisions with H_2 molecules show that for perpendicular orientation of canal-ray and magnetic-field axes the intensity due to vibrations in a plane perpendicular to the field axis is greater than the intensity parallel to the field; conversely for parallel orientation of ray and field axes the parallel intensity is the greater. The observations are explained on the basis of Stark's concept of an axial structure and orientation of the emitting electron in the electric field. The ratio of parallel to perpendicular intensity in the case of collisions perpendicular to the field decreases as the magnetic field strength is increased and increases towards unity as the gas pressure is decreased. [See also *Zeits. f. techn. Physik*, 19. 12. *pp.* 582–584, 1938.] J. E. K.

723. Quadratic Zeeman Effect. F. A. Jenkins and E. Segrè. *Phys. Rev.* 55. *pp.* 52–58, *Jan.* 1, 1939.—The Zeeman effects of the principal series lines of Na and K in the range $n = 10$ to 35 are observed in absorption, using the new 60-in. cyclotron magnet. With a field of 27,000 gauss, the lines having n in the neighbourhood of ten show a normal triplet representing the complete Paschen-Back effect of the narrow ^2P doublet. From about $n = 12$ to 20 all components show an increasing displacement toward short wave-lengths proportional to $(n^*)^4$, the shift of the π components being half that of the centre of the two σ components. This is the quadratic Zeeman effect, varying as H^2, and is here measured and compared quantitatively with theory for the first time. The agreement with the simple theory is excellent as far as $n = 20$. Beyond this the lines show an additional displacement in the same direction, increasing as a higher power of n. At the same time the lines are broadened toward the red, with indications of an unresolved component whose intensity increases rapidly with n. The displacement is interpreted as a perturbation by the F states, whose separation from the P states in this region becomes comparable with the magnetic energy. The additional lines causing the broadening represent forbidden transitions $^2S \rightarrow {}^2F$. Beyond $n = 28$ the broadening increases suddenly and becomes symmetrical, until the lines are no longer distinguishable at $n = 35$. All of these perturbation effects are compared with the theoretical results given in the accompanying paper by Schiff and Snyder [see following Abstract]. Some features are accounted for quantitatively, while the others are satisfactorily explained qualitatively.
AUTHORS.

724. Theory of Quadratic Zeeman Effect. L. I. Schiff and H. Snyder. *Phys. Rev.* 55. *pp.* 59–63, *Jan.* 1, 1939.—The experiments of Jenkins and Segrè [see preceding Abstract] are considered theoretically. The quadratic Zeeman effect observed in absorption to large orbits in strong magnetic fields is due to the diamagnetic term in the Hamiltonian, which is proportional to the square of the vector potential and hence to the square of the magnetic field. For the alkalis, the problem involves essentially only one electron, and its spin can be ignored. m_l and parity are always exactly defined, while n and l are not. The observed spectrum can be divided up with increasing n into three regions, according as the lines are broadened asymmetrically (region I), broadened further, but nearly symmetrically (region II), and broadened so much as to overlap into a continuum (region III). It is shown that region I corresponds to n being a good quantum number and l a fairly good one; region II to n being a fairly good quantum number and l not good at all; and region III to both n and l breaking down completely as quantum numbers. Good quantitative agreement with the experiments is obtained as long as inter-n perturbations can be neglected. When this can no longer be done (large n), the theory becomes prohibitively complicated, although some qualitative indications can still be obtained from it. AUTHORS.

725. Stark Effect of Hydrogen and Centre-to-Limb Variations in Contours of $H\beta$, $H\gamma$ and $H\delta$. D. S. Evans. *Roy. Astron. Soc., M.N.* 99. *pp.* 17–32, *Nov.*, 1938.—The derivation of equivalent widths of the Balmer lines by Verweij, taking Stark effect into account, depends on Pannekoek's work, which is based on Kramer's theory. Verweij's theory accounts for the width of the Balmer lines, and the object of the present work is to study the centre-to-limb variations in intensity in order to compare the results with the observations of Redman on the eclipsing binaries U Cephei and U Sagittæ. The observed intensity decrease is reproduced qualitatively by the Pannekoek-Verweij theory. The computations are based on tables given by Pannekoek and Verweij, and on the formulæ for the formation of lines at the limb given by Woolley [see Abstract 540 (1938)]. AUTHOR.

726. Infra-Red and Raman Spectra of Ammonium Salts. M. Freymann, R. Freymann and Yeou Ta. *Comptes Rendus*, 207. *pp.* 728–731, *Oct.* 24, 1938.—NH_4Cl was investigated, but no new result was obtained. NH_4NO_3 was examined in the crystalline state at room-temperature, and molten at 160° C., also in solution at a concentration of 6 gm./cm.^{3} and the results are reported. In the infra-red, an absorption-band is found in molten NH_4NO_3 at 1·0595μ, corresponding to the third harmonic of the 3165 cm^{-1}. band found in the Raman effect. A. C. M.

727. Application of New Method of Analysis to Raman Spectra of PCl_3 and PCl_5. H. Deslandres. *Comptes Rendus*, 207. *pp.* 753–757, *Nov.* 2, 1938.—Analysis of Raman spectra of PCl_3, PCl_5 (solid and liquid) by the new method [see Abstract 3729 (1938)] indicates the following predominant arrangements of atoms in the molecules:—for PCl_3, $PCl\text{-}Cl_2$: for PCl_5 (liquid), $PCl_2\text{-}Cl_3$; $PCl\text{-}Cl_4$: for PCl_5 (solid), $PCl_3\text{-}Cl_2$. W. R. A.

728. Origin of New Low-Frequency Raman Lines in Solids. J. Gupta. *Indian Journ. Phys.* 12. *pp.* 355–361, *Nov.*, 1938.—Following a previous communication on the subject [see Abstract 2909 (1938)] observations with the Raman spectra of tartaric acid, sodium tartrate and benzophenone crystals have been recorded, which go against the possibility of the new lines being due to lattice oscillations. The specific heat values of CS_2 at low temperatures have been found to agree closely through a long range of temperatures with those derived from the new frequencies of the substance in the solid state, by taking these as Einstein and not Debye frequencies. AUTHOR.

729. Polarisation of Low-Frequency Lines of Scattering in Crystals. F. Gross and M. Vuks. *Acta. Physicochimica*, 9. 2. *pp.* 209–214, 1938. *In English.*—The polarisation of low-frequency lines in the Raman spectra of diphenyl ether and *p*-dibrombenzene crystals was investigated. Various values from $\rho_n = 0$ to $\rho_n > 1$ for the coefficients of depolarisation were found. A case of anomalous polarisation with $\rho \gg 1$ in a *p*-dibrombenzene crystal was observed. The low-frequency Raman lines cannot be distinguished by the state of their polarisation from the ordinary vibrational Raman lines in crystals. From this point of view an explanation of the strong depolarisation of the continuous spectrum in the vicinity of the Rayleigh line in liquids is given. AUTHORS.

***730. Far Infra-Red Recording Spectrograph. H. M. Randall and F. A. Firestone.** *Rev. Sci. Instruments*, 9. *pp.* 404–413, *Dec.*, 1938.—This spectrograph records upon sheets of photographic paper 20 × 30 in. in size, spectra lying in the range between 18 μ and 200 μ. Of this range, 9 μ may be spread over a single record, or as much as 100 μ may be covered, depending upon the gratings and the adjustments used. The spectrograph is a vacuum instrument of high resolving power, being capable of separating sharp lines somewhat closer than 0·5 cm^{-1}. apart. Detailed drawings of its construction together with several records are shown and described. The recorded galvanometer deflections are usually adjusted to lie between 100 and 300 mm. AUTHORS.

See also Abstracts 502, 602, 679, 680, 754, 761, 767, 809, 812.

TRANSMISSION.

731. Infra-Red Transmission of Organic Compounds near the Melting Point. R. Taschek and D. Williams. *J. Chem. Phys.* 7. *pp.* 11–13, *Jan.*, 1939.—The transmission of benzophenone, desoxybenzoin, diphenyl ketone, and benzalacetophenone has been measured at various temperatures. The spectra of the compounds are affected only slightly by change of state, the most marked difference being a variation in the intensity of certain bands. Isochromatic curves for benzophenone and desoxybenzoin indicate pronounced differences in background transmission at temperatures immediately below the melting point with a rapid increase at the melting point, while those for dibenzyl ketone and benzalacetophenone show only a rapid increase in transmission on melting. The data for benzophenone and desoxybenzoin are interpreted as indicating the existence of a mesophase near the melting point. AUTHORS.

See also Abstracts 660 and
261B. Transmissivity of Electrical Non-Conductors for Heat Rays. E. Eckert.

VISION.

732. Electrical Response of the Grasshopper Eye. T. L. Jahn and F. Crescitelli. *J. Cell. and Comp. Physiol.* 12. *pp.* 39–55, *Aug.* 20, 1938.—A method is described which permits the study of the electrical responses to illumination of the intact grasshopper eye over a period of 72 hr. The response of the dark-adapted eye to brief flashes of light is described by a simple wave consisting of a rapid rising limb and a slow descending limb. The response of the light-adapted eye consists of an initial rapid wave and a secondary slower wave. With longer exposures (0·5 sec.) a third element appears on the declining limb of the response. This so-called off-effect increases with light adaptation. W. D. W.

***733. Intensity Discrimination in the Human Eye. Part II. S. Hecht, J. C. Peskin and M. Patt.** *J. Gen. Physiol.* 22. *pp.* 7–19, *Sept.* 20, 1938.—A new apparatus is described for measuring visual intensity discrimination over a large range of intensities, with white light and with selected portions of the spectrum. For white and for all colours the fraction $\Delta I/I$ decreases as I increases and reaches an asymptotic minimum value at high values of I. With white light the relation between $\Delta I/I$ and I shows two sections, one at low intensities and the other at high intensities, the two being separated by an abrupt transition. With extreme red light the relation shows only a high intensity section corresponding to cone function, while with other colours the low intensity rod section appears and increases in extent at shorter wave-lengths. [For Part I see **J. Steinhardt,** *ibid.* 20. *p.* 185, 1936.] W. D. W.

734. Relation of Transient Orange to Visual Purple and Indicator Yellow. R. J. Lythgoe and J. P. Quilliam. *J. Physiol.* 94. *pp.* 399–410, *Dec.* 14, 1938.—Visual purple solutions were rapidly bleached in an intense light and the changes in density were followed at several wave-lengths. Transient orange is first formed and has an absorption equal to that of the parent visual purple at a wave-length between 470 and 480 $m\mu$. In a solution at pH 7·13 the density at wave-lengths longer than 412 mμ decreased during the dark reaction, but at wave-lengths shorter than 412 mμ the solution increased in density showing that another substance, indicator yellow, was being formed. The early changes in a more acid solution are similar, but subsequently the absorption curves show that indicator yellow begins to decompose. The dark reaction is therefore composed of two separate reactions, the thermal conversion of transient orange into indicator yellow and the thermal decomposition of indicator yellow to colourless products. W. D. W.

735. Mode of Action of Visual Purple on the Rod Cell. R. Granit, T. Holmberg and M. Zewi. *J. Physiol.* 94. *pp.* 430–440, *Dec.* 14, 1938.—Experiments were carried out to find whether a reduction of the electrical response to a constant test light, 0·50 μ, caused by means of adaptation to monochromatic light, is accompanied by a measurable reduction of the amount of visual purple obtainable from such eyes. Tests were made on the dark-adapted excised eye of the Hungarian frog. The results show that the total quantity of visual purple obtained from eyes in which the retinal electrical response has been reduced by one-third to one half by adaptation, is the same as in the control eyes. An explanation is put forward to account for the phenomenon, in relation to the fact that the electrical response increases during regeneration of visual purple and must be somehow determined by the amount of photosensitive material available. W. D. W.

***736. Colorimetric Equipment for Research on Vision. W. D. Wright.** *Journ. Sci. Instruments*, 16. *pp.* 10–19, *Jan.*, 1939.—Two spectra are formed by means of a dispersing system and dividing mirror. From one spectrum, two strips are reflected back through the dispersing system into a photometer prism to act as the instrument primaries, and from the other spectrum two strips are reflected back to provide a comparison field. The apparatus may be used as a trichromatic colorimeter or spectrophotometer, and for measurements on luminosity and on hue and saturation discrimination. Alternatively, the primaries can be viewed in the left eye and the comparison field in the right eye in order that the effects of adaptation may be measured by binocular matching. The observer's head can be fixed by means of a dental impression. AUTHOR.

See also Abstract 691.

X-RAYS.

737. Continuous X-Ray Emission. H. Kulenkampff. *Ann. d. Physik*, 33. 7. *pp.* 600–606, *Dec.*, 1938.—If the assumption is made that, for a thin antikathode after averaging over all angles, the spectral intensity per unit frequency is constant between zero frequency and the maximum frequency, the complete intensity distribution for each angle can be obtained from experimental data. The resulting curves are compared with theory, in particular as regards angular distribution at maximum frequency. Agreement is generally satisfactory, but the angle belonging to the maximum intensity, and the width of this maximum do not completely agree with the theoretical figures. R. P.

738. Compton Effect. E. Góra. *Acta Physica Polonica*, 7. 2. *pp.* 159–176, 1938. *In German.*—It is indicated how the introduction by Heisenberg of an introductory process has made possible a more exact solution of the wave equation for indirect processes, in place of the first approximation used hitherto. The results obtained allow themselves to be evaluated in the framework of the usual theory if it is assumed that the

duration of the introductory process is much shorter than that of the entire process. The total course of the process must then be almost independent of the introductory process. Effective cross-sections for the Compton effect result from the formulæ so obtained. For wave-lengths of the quanta concerned of the order of magnitude of the classical electron radius, these cross-sections are much smaller than those given by the Klein-Nishina formula obtained in the first approximation. For the hardest γ-rays the calculated deviations should be already observable.
G. O. B.

739. Anomalous Dispersion of X-Rays in Calcite. R. M. Whitmer and G. A. Lindsay. *Phys. Rev.* 54. *pp.* 988–993, *Dec.* 15, 1938.—The index of refraction of calcite ($CaCO_3$) for X-rays has been investigated in the wave-length range from 2880 to 3550 X.U., which includes the K absorption edge of Ca. The method is such that all of the incident beam enters the crystal through an artificial face, ground so that after reflection from the (100) planes a part of the beam emerges through this face at a sufficiently small angle to be refracted appreciably. At the same time another part of the beam emerges from a cleavage face at a large angle and is refracted only a little. The separation between the two is a measure of the index. The continuous spectrum is used rather than emission lines, thus enabling measurements to be made as closely spaced in wave-length and as near the absorption edge as is desired. The absolute accuracy of the method in its present form is probably not great, but the relative accuracy is sufficient to show a distinct dip in δ/λ^2 in the vicinity of the absorption edge. A comparison is made with Hönl's theoretical curve.
AUTHORS.

740. Absorption of X-Rays of Wave-Length $1{\cdot}5 \leq \lambda \leq 8{\cdot}3$ Å. C. L. Andrews. *Phys. Rev.* 54. *pp.* 994–999, *Dec.* 15, 1938.—The mass absorption coefficients for Be 4, C 6, Al 13, Cu 29, Ag 47 and Au 79 have been determined in the wave-length region $1{\cdot}5 \leq \lambda \leq 8{\cdot}3$ Å. Only characteristic line radiation obtained with a vacuum spectrometer was used. Because of the presence of about 1% of heavier impurities in the Be 4, the apparent absorption coefficients for Be 4 may be as much as 100% higher than for the pure element. This large effect of a small amount of impurity on the apparent absorption coefficient of Be 4 leads to a suggested method of microanalysis for heavy impurities in elements of low atomic number. Following Jönsson's procedure, a universal absorption curve is plotted.
AUTHOR.

741. Auger Effect and Relative Intensity of L-Emission Lines. K. W. de Langen. *Physica,* 6. *pp.* 27–32, *Jan.,* 1939. *In English.*—The relative intensities of the lines $L\beta_1$, $L\beta_3$ and $L\beta_4$ are determined for Zr, Nb and Mo by a photographic method. The lines $L\beta_3$ and $L\beta_4$ relative to $L\beta_1$ are more intense for Mo than for Zr and Nb. This is in accordance with the theory of Coster and Kronig [see Abstract 1693 (1935)] for the Auger effect $L_{I} \rightarrow L_{II}$ with ejection of an $M_{IV\ V}$ electron, which can take place for Zr but not for Mo since for this the energy difference $L_{I} - L_{II}$ is too small. The intensity of satellites of $L\beta_1$ for the same elements has also been measured. **Errata,** *ibid. p.* 240, *Feb.* 1939.
AUTHOR.

742. Effect of Chemical Combination on K Fluorescent X-Ray Emission Lines. L. Obert and J. A. Bearden. *Phys. Rev.* 54. *pp.* 1000–1004, *Dec.* 15, 1938.—The width and index of asymmetry of the fluorescent $K\alpha_1$, $K\alpha_2$ and $K\beta_1$ emission lines of pure Zn, Cu, Fe, Mn, Cr and 26 compounds, including the halides and sulphides of Cu and Fe, have been

measured with a double-crystal spectrometer. The changes between the shapes of the lines of the metals and their oxides are in good agreement with those determined by Roseberry and Bearden [see Abstract 4255 (1936)] for the same emission lines produced by direct excitation (electron impact), and indicate that the method of excitation does not influence the shape of the lines. A study of the Cu and Fe halide and sulphide lines shows some regularities in the change of the width and index of asymmetry with the percentage composition, the most outstanding of which are for the iron sulphides FeS, Fe_3S_4, Fe_2S_3, FeS_2. As the percentage of S increases, both the width and the index of asymmetry decrease for all lines, the maximum change being of the order of 40% for the width of the $K\alpha_1$ lines.
AUTHORS.

743. Fine Structure of X-Ray K-Absorption Edges of α-, β- and γ-Iron. D. Coster and H. Levi. *Physica*, 6. *pp.* 44–46, *Jan.*, 1939. *In English.*—The fine structure of the X-ray K-absorption edges of α-, β- and γ-Fe have been measured on samples of Fe foil heated to various temperatures in an apparatus in which precautions are taken to prevent oxidation. The foil could be heated to 940° without undergoing change. The fine structure of γ-Fe (at 940°) is quite different from that of α-Fe; γ-Fe has a face-centred cubic lattice, whereas both α-Fe and β-Fe have body-centred cubic lattices. The fine structures of α-Fe and β-Fe are essentially the same. W. R. A.

744. X-Ray Absorption Spectra. T. Magnusson. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 26*B*. 1. [7 *pp*.], 1938. *In English.*—Details are given of an investigation into the structure of the K-absorption edges of the elements C, N and O, the plates being examined photometrically in every case and the wave-lengths obtained from the photometric curves.
A. H.

745. Resolving Power and Penetration of X-Rays in Mosaic Crystals. V. Dolejšek and M. Ježek. *Comptes Rendus*, 207. *pp.* 985–987, *Nov.* 21, 1938.—It is known that there is a greater penetration of X-rays into a mosaic crystal than into an ideally perfect crystal, with a consequent lowering of the resolving power, but that the direct influence of the mosaic structure may be eliminated by a symmetrical spectrograph arrangement. With a penetration of 0·01 mm. into a NaCl crystal, a mean wave-length (CuKα) and normal spectrograph distances the broadening may be estimated as 10″. A mosaic imperfection corresponding to some 100″ manifests itself, in a symmetrical spectrograph, only by several tenths of a second, *i.e.*, an effect much smaller than the smallest possible imperfection with a perfect crystal in an asymmetrical arrangement. It is possible to obtain with mosaic crystals a resolving power equal to that for perfect crystals. C. J. B. C.

See also Abstract 805.

HEAT.

CALORIMETRY.

746. Heat Capacity of Rochelle Salt. J. F. G. Hicks, Jr. and J. G. Hooley. *Am. Chem. Soc., J.* 60. *pp.* 2994–2997, *Dec.*, 1938.—The heat capacity of Rochelle salt from 15 to 340° K. has been measured. A single

measurement of the heat of transition at 328·78° K. (55·6° C.) has been made. The transition is sharp. No discontinuous changes in heat capacity were observed at the Curie points. The observations at the upper Curie point are in conflict with those reported by Kobeko and Nelidow and Rusterholz. The desirability of further investigations on Rochelle salt and other " Seignette electric " compounds has been pointed out.
AUTHORS.

747. Heat Capacity of Rochelle Salt. A. J. C. Wilson. *Phys. Rev.* 54. *pp.* 1103–1109, *Dec.* 15, 1938.—The heat capacity of Rochelle salt has been measured in the temperature range − 30° to + 30° C. by the method of adiabatic electric heating. Two samples of the salt have been investigated, one consisting of eleven single crystals of total weight about 123 gm., the other of small crystals, almost a powder, of total weight about 58 gm. The heat capacities of the two samples are nearly the same. They are well represented (mean deviation of individual points 0·3%) by the straight lines : $C_p = 1\cdot290 + 0\cdot0031t$ (crystals) ; $C_p = 1\cdot289 + 0\cdot0034t$ (powder). The heat capacity is in joule/gm. °C. ; t is in °C. There are indications of anomalies at approximately − 18° and possibly + 24° C. but the maximum departure from the straight lines is less than 1%. The direction of the indicated anomalies and their order of magnitude is in agreement with theory. The small amplitude of the anomaly at + 24° is not in agreement with the measurements of previous observers.
AUTHOR.

***748. Differential Calorimeter. N. Fontell.** *Soc. Scien. Fennica, Comm. Phys.-Math.* 10. 1–5. [18 *pp.*], 1938.—A differential calorimeter of simple construction is described in full detail. The heats of solution of KCl at 22·5° and 25° were measured, the amount of salt dissolved in 1kg. of H_2O varying from 0·5 to 6·0 gm. The values obtained were compared with the results of other investigators, in order to obtain a measure of the accuracy of the differential calorimeter. By this means it is shown that if the water equivalent of each calorimeter is 1kg. and the temperature difference between them can be determined to within $1\cdot5 \times 10^{-4}$ °C., then quantities of heat between 35 and 350 cal. can be measured with an accuracy of 0·1%.
S. W.

See also Abstract 760.

CONDUCTION.

See Abstracts 758, 790.

CONVECTION.

749. Properties of Vertical Trajectories in Two-Dimensional Convection Problems. V. Volkovisky. *Comptes Rendus,* 207. *pp.* 1166–1168, *Dec.* 12, 1938.—Boussinesq's equations are generalised and made applicable to viscous fluids by adding the term $\nu\triangle\vec{V}$ to the customary hydrodynamical equation. The results are applied to the two-dimensional flow of, and temperature distribution in, fluid heated from below and to the phenomenon of band vortices.
J. S. G. T.

See also Abstract
217B. Heat Transfer from Tubular Elements. R. Benke.

DILATATION.

750. Thermal Expansion of Rock-Salt by X-Ray Reflection. S. Basu and A. T. Maitra. *Indian Journ. Phys.* 12. *pp.* 305–316, *Nov.*, 1938.—Coefficients of expansion for rock-salt are investigated by the X-ray reflection method from 30° C. to 450° C. It is shown that values of the coefficients vary according as mean, true or zero coefficients are considered. The expression for calculating the distance between the cleavage planes of rock-salt at different temperatures, up to the range investigated, is found to be $2\cdot81400\,[1 + \cdot00004162\,(t - 18)]$ in Å units. The effect of temperature on the intensity of reflection from the cleavage face of rock-salt is also studied for a few temperatures ranging up to 300° C. AUTHORS.

FUSION AND SOLIDIFICATION.

See Abstracts 503, 763.

TEMPERATURE.

751. True Temperature Scale of an Oxide-Coated Filament. C. H. Prescott, Jr. and J. Morrison. *Rev. Sci. Instruments,* 10. *pp.* 36–38, *Jan.,* 1939.—Following Worthing [see Abstract 1509 (1924)] the spectral emissive power may be obtained from measurements of the reflection coefficient. This method is applicable to the oxide-coated filament both at room temperature and at normal operating temperatures. For a particular type of filament containing dispersed Ni the reflection coefficient averaged 36% independent of temperature and independent of the degree of activation, *i.e.*, the content of free alkaline earth metal. AUTHORS.

***752. Method for Determining Uniformity of Temperature in Cryostats. M. Shepherd.** *Bureau of Standards, J. of Research,* 21. *pp.* 831–834, *Dec.,* 1938.—This note reports a sensitive method by which the uniformity of temperature in cryostats (or other constant-temperature baths) may be determined. The method involves the measurement of differences of saturation pressures of a suitable substance (which need not be critically pure) by means of a very easily constructed differential manometer. Such an instrument is capable of differentiating temperature effects at the surface and within the bath, and offers some interesting possibilities in studying low-temperature baths. AUTHOR.

See also Abstracts 500, 545.

THERMOCHEMISTRY.

753. Thermochemical Constant and its Relations With Energy Values. M. Brutzcus. *Comptes Rendus,* 207. *pp.* 1209–1211, *Dec.* 12, 1938.—The energies of hetero- and homo-polar bonds (*e.g.*, C–H, C = S, O = O, etc.) and of excitation necessary to increase valency (*e.g.*, $C^{II} \rightarrow C^{IV}$, $S^{IV} \rightarrow S^{VI}$, etc.) are multiples of a unit varying between 48·7 and 58·2 by a whole number, or a whole number and a half (*e.g.*, by 1, 2, 3, etc. or 1·5, 2·5, etc.). This constant represents the energy of transfer of an electron from orbit L to N, the half thereof to transfer from M to Q. Deviations from the exact amounts, where not due to inaccurate determinations, are attributed to energy of vibration (a few cal.) or rotation (about 1 cal.). [See Abstract 2941 (1938).] C. A. S.

754. Relation Between Force Constant, Internuclear Distance and Heat of Rupture of a Linkage. J. J. Fox and A. E. Martin. *Chem. Soc., J. pp.* 2106–2109, *Dec.,* 1938.—Values of the heats of rupture of C–H and C–C linkages are calculated on the assumption that all C–H linkages have very nearly the same heat of rupture. This assumption is justified by force-constant data obtained from spectroscopic observations.

It is shown that a smooth curve is obtained by plotting heat of rupture and internuclear distance for various C–C linkages and in some simple cases thermochemical data may be used to determine internuclear distances.
AUTHORS.

755. Deflagration and Detonation in a Combustible Gaseous Mixture at Constant Volume. M. Véron. *Comptes Rendus*, 207. *pp*. 1037–1039, *Nov*. 28, 1938.—A new theory of detonation is given and is shown to account for a number of phenomena which occur within the combustion chamber. R. W. P.

756. Combustion of Hydrocarbons. D. T. A. Townend. *J. Inst. F.* 12. *pp*. 78–86, *Dec*., 1938.—This paper reviews much previous work on the combustion and ignition of hydrocarbons. It deals in particular with combustion by intermediate stages of methane, ethane and ethylene; the cool flames obtained with the higher hydrocarbons and other combustibles; the relation between ignition pressures and "knock" ratings; and recent observations on two-stage ignition involving cool flames. G. G.

757. Propagation of Flame in H_2–O_2 Mixtures. W. E. Garner and A. Pugh. *Faraday Soc., Trans.* 35. *pp*. 283–295, *Jan*., 1939.—Measurements have been made of the pressure limits for the H_2–O_2 flame in quartz and silica vessels. The effects of tube diameter and length, and the influence of the energy of firing have been studied. It is shown that it is possible to propagate flame down to 0·4 cm. pressure in tubes with 10 cm. dia. The limit varies inversely as the diameter. It is concluded that in the absence of wall effects flame in H_2–O_2 mixtures can be propagated down to very low pressures. The effect of inert gases, and variation of composition indicates that the factor controlling flame propagation at low pressures is the conduction of heat to the walls. Conclusions are drawn with regard to the part played by chain carriers and thermal conductivity in the propagation of flame at atmospheric pressures.
AUTHORS.

See also Abstracts 509, 748.

THERMODYNAMICS.

758. Thermal Supraconductivity of Liquid Helium II and Bose-Einstein Statistics. L. Tisza. *Comptes Rendus*, 207. *pp*. 1035–1037, *Nov*. 28, 1938.—F. London has intepreted the λ-point of liquid He as being the condensation temperature of a Bose-Einstein gas. (See *Nature*, 141. *p*. 643, *April* 9, 1938.) The present author gives a generalised account of this conception, and from the properties of the two resulting phases it is found possible to account for the abnormally large rates of heat flow obtained with liquid He. Equations are derived for the quantity of heat flowing, which, although they await complete quantitative confirmation, are in accord with experiment in giving a flow of heat which increases at a slower rate than the applied temperature difference. R. W. P.

759. Viscosity of Liquid Helium and Bose-Einstein Statistics. L. Tisza. *Comptes Rendus*, 207. *pp*. 1186–1189, *Dec*. 12, 1938.—By the application of Bose-Einstein statistics it has been found possible to account for the abnormal heat conducting properties of liquid He II [see preceding Abstract]. Recognition of the existence of the two phases arising from this treatment, one of which has a gas-like kinetic viscosity and the other has not, enables explanations to be suggested, not only for the fountain and creep phenomena exhibited by liquid He, but also for the diverse experimental results obtained for its viscosity under different working conditions. R. W. P.

760. Internal Rotation of Propane and Propylene. Origin of Internal Restricting Potentials. G. B. Kistiakowsky, J. R. Lacher and W. W. Ransom. *J. Chem. Phys.* 6. *pp.* 900–901, *Dec.*, 1938.—The heat capacities of propane and propylene down to 148° K have been determined by the " hot wire " method, and the contribution to the heat capacity of the internal rotation of the molecules evaluated. Comparing these results with the data of Pitzer [see Abstract 3191 (1937)] for the isothermal dependence of the rotational heat capacity upon the restricting potential, the authors conclude that propane possesses an internal potential of from 3200 to 3600 cal./mol. and propylene about 600 to 800 cal./mol. The idea that the H interactions are the cause of restricting potentials is discarded, and instead it is proposed that the restricting potentials are due to an interaction of electron pairs forming single bonds on adjacent polyvalent atoms. Evidence in support of this hypothesis is given. S. W.

761. Equilibrium Dissociation and Thermodynamic Constants of NOCl. Comparison with Spectroscopic Data. C. M. Beeson and D. M. Yost. *J. Chem. Phys.* 7. *pp.* 44–52, *Jan.*, 1939.—Careful measurements of the equilibrium dissociation of NOCl into NO and Cl_2 have been made in the temperature range 100–220°. Pressure-temperature measurements at 0°–100° on mixtures of NOCl and NO were made and from them the second virial coefficients of NOCl gas were calculated. These vary from -389 cm^3./mol. at 0° to -196 cm^3./mol. at 100°. The virial coefficients were used to correct the measured equilibrium constants to those for perfect gases. Equations for free energy, entropy and heat content changes accompanying the dissociation were derived as functions of the temperature. The experimentally found entropy changes for the reaction were found to be less than those calculated from spectroscopic data by $3\cdot61 \pm 0\cdot3$ cal./deg. To attain agreement, the spectroscopic entropy of NOCl must be increased by $1\cdot8$ cal./deg., and this was attained by assuming that an observed infra-red frequency at 923 cm^{-1}. is a combination, 633 + 290 cm^{-1}. For the reaction $2NOCl(g) = 2NO(g) + Cl_2(g)$, $\Delta F^\circ_{298} = 9720 \pm 60$ cal., $\Delta S^\circ_{298} = 28\cdot0 \pm 0\cdot5$ cal./deg. $\Delta H^\circ_{298} = 18{,}060 \pm 200$ cal. $S^\circ_{298}(NOCl) = 63\cdot0 \pm 0\cdot3$ cal./deg. AUTHORS.

See also Abstracts 471, 515, 516, 518, 765, 799, 821.

VAPORISATION AND CONDENSATION.

762. System Correlating Molecular Structure of Organic Compounds with their Boiling Points. Part I. Aliphatic Boiling Point Numbers. C. R. Kinney. *Am. Chem. Soc., J.* 60. *pp.* 3032–3039, *Dec.*, 1938.—A method has been devised for correlating the structure of organic compounds with their boiling point. Boiling point numbers for a variety of atoms, groups and molecules are obtained and the accuracy discussed. Methods for calculating the boiling point of a compound from its structure and the structure from the boiling point are outlined. The combined effect of several groups in the molecule upon the boiling point is discussed. AUTHOR.

763. Properties of Purified Normal Heptane and Iso-Octane. D. B. Brooks. *Bureau of Standards, J. of Research*, 21. *pp.* 847–852, *Dec.*, 1938.—Normal heptane and " iso-octane " (2,2,4-trimethylpentane) are used universally as the primary standard reference fuels for the knock rating of automotive engine fuels. In developing specifications for these standards, it became apparent that data were needed on the physical properties of samples of the highest possible purity. Material already of high purity was carefully fractionated through columns having an efficiency equivalent to that of 60 theoretical plates. The important properties of the purest fractions obtained thereby were accurately measured. In each case the freezing point of the best material obtained was higher than currently accepted values. AUTHOR.

***764. Azeotropic Distillation. H. Guinot and F. W. Clark.** *Inst. Chem. Eng., Trans.* [8 *pp.*], 1938.—Azeotropic mixtures are binary and ternary constant boiling mixtures, and they are now used in the preparation of a number of substances. A brief historical account of the development is first given and then the manufacture of absolute alcohol, ethers, diethyl acetal, acetic anhydride, and the concentration of acetic and formic acids are given. The plant required is briefly described and precautions which have to be taken to avoid trouble are mentioned. The substances mentioned are only examples of the possible uses of the process. E. H. D.

765. Equilibria in Two-Phase, Gas-Liquid Hydrocarbon Systems. Part IV. E. H. Boomer, C. A. Johnson and A. G. A. Piercey. *Canad. J. of Research*, 16. *Sect. B*. 396–410, *Nov.*, 1938.—The densities and compositions of both phases in the methane-*n*-heptane solubility equilibrium have been determined at 25°, 55° and 85° C. at total pressures from 35 to 250 atm. The critical pressures of complete miscibility were found, and the properties of the system are discussed. The nitrogen-*n*-heptane system was investigated similarly at 100·9 atm. and temperatures from 25° to 115° C. The system composed of Viking natural gas and impure heptanes was also investigated at 25° C. The three systems, methane-pentane, -hexane and -heptane are compared and discussed. [For Part III see Abstract 5004 (1938).] AUTHORS.

766. Vapour Pressure of Molten Alkali Chlorides. W. Kangro and H. W. Wieking. *Zeits. f. phys. Chem.* 183. *Abt.A.* 3. *pp.* 199–208, 1938.—The vapour pressure of LiCl, NaCl, KCl, RbCl and CsCl have been determined from 860–990° C., by the method which involves passing a stream of N_2 over the molten salt at different velocities, and measuring the rate of loss of salt. The required pressure is obtained by extrapolation to zero velocity. The results are given in tabular form and a comparison is made with other literature. It appears that the Duhem equation is satisfied, and further that the melts do not behave as ideal solutions.
E. H. D.

See also Abstracts 552, 559, 626, 703 and
216B. Heat Transfer to Boiling Liquids. F. H. Rhodes and C. H. Bridges.

ACOUSTICS.

767. Persistence of Molecular Vibration in Collisions. R. J. Dwyer. *J. Chem. Phys.* 7. *pp.* 40–44, *Jan.*, 1939.—The dispersion of sound is theoretically interpreted by the idea that the exchange of energy in collisions between molecular *translation* and *rotation* on one side and *vibration* on the other side is much slower than, for example, between the various translational degrees of freedom. It seemed desirable to find a direct optical method of observing this hypothetical effect. Apparatus has been developed for the purpose of investigating molecules present in very small concentration, like radicals, by their absorption spectra; with this method, relative concentrations of molecules are determined by comparing intensities of certain rotational lines. This test was applied to the higher vibrational levels of the I_2 molecule. Their concentration was artificially increased beyond the small amount present in thermal equilibrium by an electric discharge of brief duration. By varying the phase between an electric switch and optical shutter, snapshots of the absorption spectrum could be taken at different intervals after the discharge was interrupted. The result was that I_2 molecules raised from the ground level to the first excited vibrational level are able to persist in this level through several thousand collisions with other I_2 molecules before losing their vibration. AUTHOR.

768. Dynamics of Pianoforte String and Hammer. Part I. Hard Hammer. M. Ghosh. *Indian Journ. Phys.* 12. *pp.* 317–330, *Nov.*, 1938.—The dynamics of the damped pianoforte string and the hard hammer is worked out by well-known operational methods. The main idea upon which the dynamics is built up is that the string behaves like a *loaded string* so long as the hammer is in contact with it. The different cases have been worked out: (1) The hammer strikes very near the end. The expressions for the displacement and the pressure when the string is free from damping are found to be the same as those given by Kaufmann. This method, however, does not require to assume like Kaufmann's, which goes *against* experimental observations, that the shorter segment vibrates as a rigid rod during impact. For a massive hammer, expressions reduce to those that were obtained independently in a different paper. (2) The general expressions for the displacement and pressure have been also obtained, for the string struck at mid-point. Kaufmann tried this with the help of St. Venant's " variation of integration constant." But the method fails to include the damping of the string and also fails to give general expressions. (3) The general expressions for the same are also given for the semi-infinite string struck at different points from the finite end. Das also tried this with the help of the method adopted by Kaufmann but arrived at some algebraical difficulties. AUTHOR.

769. Resonance Method of Determining Velocity of Sound in Liquids. Velocity in Mercury. C. Salceanu. *Comptes Rendus*, 207. *pp.* 1184–1186, *Dec.* 12, 1938.—The apparatus is described and figured. It consists essentially of a tube containing a column of the liquid, the length of which can be varied, with a source of vibration at the lower end. Applied to Hg the velocity of sound therein at 22·5° is 1407 m./sec. [See Abstract 1694 (1938).] C. A. S.

770. Velocity and Dispersion of Sound in Cl_2. R. Schulze. *Ann. d. Physik*, 34. 1. *pp.* 41–59, *Jan.*, 1939.—Measurements were made of the velocity of sound in Cl_2 by the Thiesen resonator method at temperatures of 32°, 18°, 0° and − 25° C., using audible frequencies between 1 and 18 kc./sec. The pressure was about 1 atm. and at 0° and −25° C. measurements were also made at a pressure of 440 mm. Hg. From the measurements at 790 mm. Hg the specific heats C_v° and $X^\circ = C_p^\circ/C_v^\circ$ were calculated for low frequencies. They agree very well with values calculated from the Planck-Einstein function with $\Theta = 810$, for the temperature region in question. The results for C_v° at 440 mm. Hg and temperatures of 0° and −25° C. were in agreement with the values at atmospheric pressure. At 0° and −25° C. and 790 mm. Hg and the highest frequencies dispersion was found and from the position of the dispersion region the value of β, a thermal equilibrium constant, was calculated. The results were in fairly good agreement with values interpolated from Eucken and Becker's results [see Abstract 810 (1935)]. A shift of the dispersion region towards lower frequencies by reducing the pressure to 440 mm. Hg could not be detected, as the percentage increase of the small HCl impurity masked the effect of the pressure reduction. A. W.

771. Influence of Supersonic Vibrations on the Discharge Potential of H_2, O_2 and Cl_2. R. Piontelli. *Accad. Lincei, Atti,* 27. *pp.* 581–586, *June* 3, 1938.—The influence of vibrations at $1\cdot196 \times 10^6 \sim$ on $0\cdot1$ *N* solutions of KCl, HCl and NaOH previously reported [see Abstract 4179 (1938)] is now confirmed also for KOH, Na_2SO_4 and H_2SO_4. At high current density after prolonged exposure, polarisation in HCl shows some anomalies. A vigorous bubbling of H_2 round the kathode causes a marked initial depolarisation comparable with that caused by the vibrations. This is due probably to elimination of dissolved O_2 in the first case and certainly to mechanical slacking off of the products of discharge in the second; with bubbled N_2 and polished Pt kathode some initial depolarisation occurred but the potential gradually became more negative reaching a lower limit than with H_2. The theory of an oxide film with Pt electrodes is regarded as confirmed. In the case of Cl_2 the electrode shows the phenomenon of semi-passivity presumably from oxidation due to intense anodic polarisation. A qualitative thermodynamic explanation of the mechanism is attempted. [See also Schmid and Ehret, Abstract 4629 (1937).] D. R. H.

772. Dissipative Acoustic Reflection Coefficients in Gases by Supersonic Interferometry. R. S. Alleman. *Phys. Rev.* 55. *pp.* 87–93, *Jan.* 1, 1939.—Reflection coefficients for supersonic waves in gases, much lower than allowed by the dynamical theory of sound, first evaluated for a single frequency by J. C. Hubbard, and found by R. W. Curtis to have a frequency dependence, are satisfactorily explained by the new heat conduction theory of acoustic reflection developed by K. F. Herzfeld. This paper presents a modification of the theory of the acoustic resonator interferometer so as to include dissipative losses by emission and reflection at the source as well as losses by reflection at the reflector. The analysis of previously obtained and new data for CO_2, air, and He shows excellent agreement with Herzfeld's theory in all cases showing minimum losses. The requirements for securing such data, including the plane parallelism of source and reflector and modes of vibration of the source have been studied by optical, electrical and acoustical methods. The parallelism requirement is most rigorous and of a higher order of magnitude than for velocity determinations. Slight departures result in apparent losses of great magnitude. This requirement is best fulfilled by adjustment for maximum acoustic reaction, or peak height, while the interferometer is in actual operation. The sensitivity of the interferometer is greatly increased by blocking out unused radiation by reflecting plates at a quarter wave-length distance from the source. AUTHOR.

773. Measurement of Reverberation Time. P. Chavasse. *Comptes Rendus,* 207. *pp.* 979–981, *Nov.* 21, 1938.—The theory of the measurement of acoustic reverberation times is based on the Sabine formula. Three arrangements for measuring reverberation times (T) are briefly discussed. (1) Linear amplifier and peak voltmeter. Differentiating the current equation it is seen that the tangent of the angle at the origin made by the tangent to the curve represented by this equation is equal to seven times the initial intensity divided by T. The peak voltmeter is joined to the secondary of a transformer whose primary is fed from the anode current of a diode in the output stage of the microphone amplifier. The sensitivity can easily be regulated by altering the turns ratio of the transformer. The sensitivity is greater as the reverberation time becomes less and experiment shows that satisfactory results are obtained for times from 0·05 to 10 sec. without distinct echo. (2) Replacing the linear amplifier by a logarithmic one covering an interval of 60 db, the current curve becomes a straight line inclined to the time axis at an angle ψ such that $\tan \psi = 7 \mu T^{-1}$, where μ is a constant of the apparatus. (3) A fluxmeter connected in circuit for only a limited time τ, which is less than T, may be substituted for the milliammeter in the above. The sensitivity of this method, as with both the others, is inversely proportional to T. The use of a voltmeter with a logarithmic characteristic enables a sensitivity to be obtained comparable with that of the ear and reduces the importance of sounds picked up by the microphone after stopping the sound source. A. W.

774. Technique of Sound Recording. T. S. Lyndon-Haynes. *Phot. J.* 78. *pp.* 727–730, *Dec.*, 1938.—The object of motion-picture sound recording is to assist directly in telling the story, and for dramatic effect. Motion-picture sound is considered under speech, "effects" and music. In a play, speech would be recorded first, effects and incidental music afterwards; in a musical play the music would come first. The singer's voice is recorded with a faint piano accompaniment; afterwards a full orchestral arrangement is made in the same tempo and mixed with the original track. Effects are of two kinds, those which can be recorded on the set (*e.g.*, telephone bell), and those that are mixed into the track in the re-recording. Every studio keeps a number of effect properties such as lead shot on a drum-skin, cocoanut shells, whistles and motor horn. Other effects can be kept in library form, as motor car and train noises, sounds of fire-bells, ship and train whistles, machine-gun firing and traffic noises. Music is considered under opening title music, songs and special numbers, background music, and end titles. The technique of sound perspective, in which the position of the microphone is important, is discussed, and also that of post-synchronisation, or the fitting of sound to a picture that has already been made. The re-recording sessions offer the last chance to smooth out the sound in a picture, and to lessen the background noise that is inherent in all recording systems. G. E. A.

775. Electrical Phenomena of the Internal Ear. J. A. Reboul. *J. de Physique et le Radium*, 9. *pp.* 428–436, *Oct.*, 1938.—Following the author's earlier paper [see Abstract 3339 (1938)] on the movements of the basilar membrane, the generation of electrical impulses in the ear is now discussed. It is suggested that the different liquids in the *scala vestibuli* and the *scala tympani* form a condenser, the dielectric of which is the basilar membrane; under the influence of periodic pressure variations in the liquids the capacity of the condenser varies and an alternating p.d. is produced across it. To simplify the subsequent mathematical treatment it is assumed that the cochlea consists of a series of condensers in parallel, one plate of each of which is attached to an individual nerve fibre, the dielectric being in the corresponding cell of the organ of Corti. An expression is deduced for the p.d. produced across one of these condensers at a given distance from the tip of the basilar membrane by an alternating pressure in the liquid. The nerve impulses thus transmitted to the brain from each element of the basilar membrane give rise to the sensation characteristic of the sound in question. It is concluded that this mechanism can supply a qualitative explanation of the well-known properties of the ear. K. M. C.

See also Abstracts 562 and
427B. Diffraction of Light by Sound Film. J. F. Schouten.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

776. Properties of Oscillatory Circuits. G. Rutelli. *Ricerca Scientifica,* 2. *pp.* 364–378, *Oct.,* 1938.—It is shown that, in a loss-free circuit consisting of a condenser in parallel with an inductance coil of zero self-capacity, the variations of the three parameters, inductance (L), capacity (C) and wave-length (λ) are related by simple equations. When L (or C) remains constant, the fractional variations in C (or L) and in λ are connected by a parabolic relation. When λ is fixed, the fractional variations of L and C are connected by a hyperbolic relation. These simple equations are special cases of more general results involving terms expressing the effect of self-capacitance. Typical families of curves are shown and their application to the measurement of inductance and capacity is described. N. F. A.

777. Resonance Curve Method for Absolute Measurement of Impedance at Frequencies of Order 300 Mc./sec. R. A. Chipman. *J. of Applied Physics,* 10. *pp.* 27–38, *Jan.,* 1939.—A general theory is developed, together with a simplified experimental procedure, which permits the absolute measurement of the magnitude and phase angle of any value of complex impedance, in terms of the characteristic impedance of a parallel-wire line to which the impedance to be measured is connected as one termination. The observed quantities are the shape of the resonance curve of the current in one of the line's terminations obtained by varying the line length, and the length of line for maximum current. The effects of distributed line resistance and of radiation resistance on the impedance measurements are discussed in detail. Examples are given of the measurement of the impedance of straight resistance wires, and of the resistance of " metallised " resistors, at a frequency of 377 Mc./sec. The accuracy of the method varies considerably throughout the total range of resistance and reactance, but is high for any combination of the two from a few ohms to a few thousand ohms. The possible accuracy varies approximately inversely as the frequency. At a frequency of 300 Mc./sec. an optimum accuracy of about 1% may be expected. In an Appendix some experimental data on the radiation resistance of a parallel-wire line are described. AUTHOR.

See also Abstract 794.

CONDUCTION AND DISCHARGE IN GASES.

778. Law of Distribution of Mobilities of Large Ions. H. le Boiteux and Ouang Te-Tchao. *J. de Physique et le Radium,* 9. *pp.* 501–504, *Nov.,* 1938.—A new method, depending on the ultramicroscopic examination of the trajectories followed by the ions subjected to the influence of an alternating electric field, has been utilised to determine the law of distribution of the mobilities of large ions produced in the smoke cloud obtained by slow combustion of a Chinese perfume. The results obtained show the existence of a most probable value in the neighbourhood of $3 \cdot 6 \times 10^{-5}$ cm./sec./V/cm. The application of the Stockes-Commingham formula to these results allows the radius of the particles in question to be calculated. The most probable radius is found to be about 2×10^{-5} cm., in agreement with the values found by other workers for different kinds of particles in suspension. A. W.

779. Arcs of Various Metals in Capillary Tubes. V. Voss. *Phil. Mag.* 26. *pp.* 1000–1006, *Dec.*, 1938.—The easiest type of Hg arc to construct is one in which the arc is run in a capillary tube [see Abstract 4141 (1937)]. Similar arcs have now been obtained with Cd, Zn, Tl, Te, Bi, Sb and Pb. The metal was cast in a narrow pyrex tube, which was then cracked off. A portion was introduced into a silica tube with two small bulbs connected by a capillary tube and suitable Mo wire electrodes. The metal was melted by means of a heating coil and the arc started by tapping so as to break the metal thread in the capillary. Such arcs run at pressures equal to or greater than atmospheric pressure. Photographs of the spectra obtained are given, with characteristic details. In each spectrum some of the lines are reversed. As the temperature and pressure rise the continuous background is enhanced, the reversals become more pronounced and new reversals may appear. Some lines which are sharp at lower temperatures broaden out and become more and more diffuse as the temperature rises. Thus the Hg group λ 2652, 2654, 2655 diffuses into one vague blur as the arc wattage is increased from 5 to 28 W. A. W.

780. Kathode Jump of Potential. H. Haake and W. Walcher. *Zeits. f. Physik*, 111. 3–4. *pp.* 174–182, 1938.—The existence conditions and general features of a typical "thread-ray" discharge are investigated; for all conditions of voltage, current and gas pressure at which the discharge is observed an Aston dark space occurs immediately in front of the kathode. The appearance of this dark region in the discharge is a visible proof of the non-existence of the large kathode potential jump of 0·3 to 0·7 times the discharge potential which Westphal asserted to exist at the kathode in this type of discharge. Westphal's experiments on the deflection of thread-ray discharges by transverse magnetic fields are repeated; the deflection characteristics obtained are readily explicable on the assumption that the potential/distance curve rises steeply near the kathode and then remains constant up to the anode and there is no need to involve the kathode-jump hypothesis by way of explanation. J. E. K.

781. Effect of Positive-Ion Bombardment on Electron Current from the Kathode in a Glow Discharge. Part IV. A. Güntherschulze, W. Bär and A. Winter. *Zeits. f. Physik*, 111. 3–4. *pp.* 208–211, 1938.—Data obtained from measurements on 11 metals and 10 metal oxides indicate that positive-ion bombardment is more effective in detaching electrons from kathodes when the work of detachment is high. Further, the smaller the work of detachment, the smaller also is the normal kathode yield. The significance of these results is discussed in relation to the mechanism of the normal glow discharge. [For Part III see Abstract 2969 (1938).] W. R. A.

782. Discussion of Neon Discharge from Standpoint of Incomplete Equilibrium in Positive Column. R. Rompe and M. Schön. *Zeits. f. Physik*, 111. 5–6. *pp.* 345–350, 1938.—Measurements of the dependence of the gradients and the light output of the Ne discharge upon the current strength are discussed in relation to the theory previously given of the positive column of the low pressure discharge, based on incomplete equilibrium [see Abstract 2118 (1938)]. When from the total power of the positive column the power of the visible and u.v. radiation is subtracted and the difference plotted against the electron density, the curve should be approximately a straight line, except in the region of very small electron densities, the slope of the line being a measure of the recombination and elastic losses in the column and its intercept on the power axis a measure of the resonance radiation power. The electron density was taken as proportional to the quotient of current strength by potential gradient, using Langevin's formula, and in about 80% of the measurements a linear relation was obtained between electron density and the difference between total power and radiation power in the Ne column. A. W.

783. Resistivity and Power Input in Cæsium Discharge at High Current Density. F. L. Mohler. *Bureau of Standards, J. of Research*, 21. *pp.* 873–881, *Dec.*, 1938.—Measurements have been made of the potential gradient and the ion current to the tube wall in a tube 5 mm. in dia. for current densities ranging from 5 to 20 A/cm^2. and vapour pressures from 0·0045 mm. to 0·33 mm. Potential gradients have also been measured in a 1-mm. tube for current densities ranging from 30 to 150 A/cm_2. and vapour pressures from 0·33 to 2 mm. Published results give electron concentrations and temperatures for this range of conditions. The resistivity agrees approximately with the theoretical value for a completely ionised gas. The power dissipation comes predominantly from wall recombination at low pressures. Above 0·17 mm. the radiation is appreciable, and above about 1 cm. the radiation would account for most of the power input. Theoretical equations are given for the case where pressure and degree of ionisation are so high that the vapour is opaque. AUTHOR.

784. Clean-Up and Pressure Effects in Low Pressure Mercury-Vapour Discharges. C. Kenty. *J. of Applied Physics*, 9. *pp.* 765–777, *Dec.*, 1938.—In a positive column discharge in Hg vapour at low pressure there occurs a type of reversible electrical clean-up in which, under equilibrium conditions a large and continuous exchange of Hg takes place between the space and the walls, the amount temporarily held in this way being several times that in the gas phase ; on account of this, if the current is suddenly stopped, the pressure may rise momentarily to several times its normal value while if it is suddenly raised from a low to a high value the reduction of pressure may be such as to cause surges across the arc or extinction of the arc. A large number of experiments investigating this phenomenon are described, the results of which are largely backed up by theoretical analysis. It is concluded that ions penetrate the walls of the tube to distances or positions of varying stability where they are held for longer or shorter lengths of time according to the effective degree of binding until they escape as a result of random heat motions occurring at the original wall temperature or at temperatures artificially elevated by external means or by ion bombardment. E. O. T.

785. Mechanism of Negative Point to Plane Corona Near Onset. G. W. Trichel. *Phys. Rev.* 54. *pp.* 1078–1084, *Dec.* 15, 1938.—Oscillographic studies have been made of the currents in negative point to plane coronas in air. The oscillograms obtained indicate that the negative corona current is composed of discrete pulses whose magnitude and frequency have a definite relationship to the corona current, point size and gas pressure. The frequency of the current pulses appears to be independent of gap length under the experimental conditions studied. The frequency of the oscillations does not appear to be affected by changes in the electrical constants of the discharge circuit outside the gap. The periodic character of the discharge seems to derive logically from space charge formation in the gap and subsequent clearing under the action of the electrostatic field. AUTHOR.

786. Ionisation Potentials of Elements under Different Ionisation Conditions. E. Lisitzin. *Soc. Scien. Fennica, Comm. Phys.-Math.* 10. 1–5. [121 *pp.*], 1938.—Section I discusses the significance of ionisation potentials and also stable atomic configurations, Section II the fundamental term of Millikan and Bowen. Section III deals with regularities in the values of ionisation potentials and in particular with Payne's investigations, Moseley's law and the Laporte-Young relation. Section IV discusses theoretical calculations of ionisation potentials, the various subsections being concerned with (1) different quantum methods and the He problem, (2) the electron affinity of H, (3) other two-electron structures, (4) three-electron structures, (5) structures similar to that of the rare gases, (6) Slater's method, (7) the method of Bacher and Goudsmit and (8) the equation of Kruger and Shoupp. Section V collects and arranges in tabular form the available data on ionisation potentials. Section VI deals with the representation of ionisation potentials by a polynomial of the second degree and Section VII gives the results of calculations and comprehensive tables of the ionisation potentials of the elements. The Bibliography appended is unusually full and includes 335 papers. A. W.

787. Dissociation of Benzene (C_6H_6), Pyridine (C_5H_5N) and Cyclohexane (C_6H_{12}) by Electron Impact. A. Hustrulid, P. Kusch and J. T. Tate. *Phys. Rev.* 54. *pp.* 1037–1044, *Dec.* 15, 1938.—The dissociation of C_6H_6, C_5H_5N and C_6H_{12} by electron impact has been investigated with a mass-spectrograph. Four doubly charged and thirty-one singly charged positive ions were observed in the dissociation of benzene. The relative abundance, for electrons of 72 V energy, and the appearance potential are given for each ion. The first and second ionisation potentials of benzene are $9\cdot8 \pm 0\cdot1$ and $17\cdot2 \pm 1\cdot0$ V, respectively. The ionisation potential of C_5H_5N is $9\cdot8 \pm 0\cdot2$ V and of C_6H_{12}, $11\cdot0 \pm 0\cdot2$ V. In each of the three vapours, certain of the ions resulting from the dissociation process have a doublet character. The components have a constant energy separation independent of magnetic field. The components also have different appearance potentials. The interpretation given is that these particular ions are formed by two different processes, one of which imparts a *definite* amount of kinetic energy to the ion. [See Abstracts 5063 (1937) and 2124 (1938).] AUTHORS.

788. Dissociation of $C_2H_2D_2$ by Electron Impact. J. Delfosse and J. A. Hipple, Jr. *Phys. Rev.* 54. *pp.* 1060–1062, *Dec.* 15, 1938.—The dissociation of $C_2H_2D_2$ by electron impact has been investigated. In order to obtain a consistent interpretation of the distribution of intensities of the different ions produced, it is necessary to assume that there is a selective process favouring the splitting of the C – H bond over the splitting of C – D. The probability p introduced to take this effect into account has been calculated. From that value of p, an estimate of the intensity of the ion C_2HD has been made, which agrees with the measured one. In addition to that, it has been shown that the formation of CH_2 in C_2H_4 is a splitting of the double bond between the carbons alone, and that in the formation of H_2^+ in C_2H_4, the H atoms come from the same radical. [See Abstracts 5063 (1937) and 2124 (1938).] AUTHORS.

***789. Optics of Positive Rays and Application to Mass-Spectrograph. L. Cartan.** *Ann. de Physique*, 10. *pp.* 426–502, *Nov.*, 1938.—The mass-spectrograph is of great importance in nuclear physics, for detecting isotopes, for collecting them in measurable quantities and for measuring their masses with precision. The optics of positive rays are therefore dealt with in some detail. A new method of focusing is employed in a new spectrograph which has about 100 times the resolving power of the Thomson apparatus. It is applied to the separation of the C isotope 12 in sufficient quantity (0·1 μ gm.) for it to be used for nuclear bombardment experiments. C. J. B. C.

See also Abstracts 626, 652, 653, 720.

CONDUCTION IN SOLIDS AND LIQUIDS.

790. Wiedemann-Franz Law in Metals. J. Meixner. *Ann. d. Physik*, 33. 7. *pp.* 682–688, *Dec.*, 1938.—A proof is given of the Wiedemann-Franz law for a metal of any crystal structure in a field of any strength or orientation. It is only necessary to assume that $T > \theta$ and that the degeneration temperature of the electron gas in the metal is sufficiently high. H. J. H. S.

***791. Photoelectrically Balanced Recording Potentiometer. C. O. Fairchild and V. L. Parsegian.** *Rev. Sci. Instruments*, 9. *pp.* 422–425, *Dec.*, 1938.—The problem of stopping a moving light-beam on the edge of a phototube without any tendency to oscillate or "hunt" and with speed and precision has been solved by a new method and a recording potentiometer is rapidly and accurately balanced. By (1) artificially cancelling the generated back e.m.f. of the moving galvanometer thus advancing its return movement from a deflected position, and (2) delaying the grid potential change of a triode amplifier in the photoelectric circuit, galvanometer lag is counteracted and the potentiometer is balanced with an accuracy of a few hundredths of a percent of the range. The total power input to the instrument is about 35 W and the contact carriage speed is made as high as 10″ in 20 sec. The fundamentals of the complete instrument are discussed and equations describing the galvanometer movement are included. AUTHORS.

***792. Measurement of Intense Currents. B. Tsaï.** *Comptes Rendus*, 207. *pp.* 850–851, *Nov.* 7, 1938.—A flexible solenoid based on the magnetic potentiometer of Chattock is used to measure d.c. of the order of 30,000 A flowing along a conductor. The solenoid forms a closed circuit which encircles the conductor and the reading obtained by a fluxmeter when the solenoid is made a closed circuit which does not encircle the conductor is a measure of the current. With the apparatus described, a relation $I = 212\theta$ A is obtained (θ = fluxmeter deflection) which allows precision measurements on currents of the order of 30,000 A. H. J. H. S.

***793. Artificial Modification of Galvanometer Constants. E. Hochard.** *Comptes Rendus*, 207. *pp.* 981–983, *Nov.* 21, 1938.—If a galvanometer is included in the circuit of a photo-cell and if this cell is illuminated by a beam controlled by the galvanometer mirror, the equation of motion of the galvanometer system is modified. Suppose the galvanometer mirror gives a uniformly lighted image in the plane of a screen with a vertical edge. The flux passing the screen is received by the photocell. A new equilibrium position is then possible and the sensitivity of the galvanometer in this new position is multiplied by a factor M, while the period and the critical resistance are multiplied by $\sqrt{M}$ (neglecting air damping). Stable arrangements were found possible using a Chauvin-Arnoux galvanometer and a Philips cell, with values of M between 5 and 10. By suitable choice of the apparatus constants it was found possible to utilise the above arrangement to obtain a uniformly luminous beam when the galvanometer lamp varies widely in brightness. A. W.

***794. Electronic Voltage Stabilisers. F. V. Hunt and R. W. Hickman.** *Rev. Sci. Instruments,* 10. *pp.* 6–21, *Jan.,* 1939.—Voltage stabilising circuits employing thermionic tubes can be classified into four groups, according to their derivation from (1) the transconductance bridge, (2) the amplification factor bridge, (3) the simple degenerative amplifier, and (4) combination circuits involving two or more of the foregoing classes or utilising amplified control voltages. It is shown that the variational performance of a stabiliser is characterised by an internal output resistance and a stabilisation ratio. The effect of source resistance on these performance parameters is discussed in the general case and expressions for these parameters are evaluated for ten stabiliser circuits, seven of which are original with the authors. All but two of the circuits can be adjusted to yield perfect stabilisation and four have also a very low internal resistance. Glow discharge tubes are discussed as bias battery substitutes. A simple a.c. bridge technique which is convenient for the experimental determination of stabiliser performance under normal load conditions is described in an Appendix. AUTHORS.

795. Theory of Rectifiers. F. H. Müller. *Phys. Zeits.* 39. *pp.* 793–795, *Nov.* 15, 1938.—It is shown from general considerations that the behaviour of a Cu_2O rectifier can be completely explained when two further conditions are added to the two enunciated previously by Waibel [see Abstract 853 (1937)]. A mathematical treatment of the problem is to follow. R. W. P.

796. Model of Blocking Layer and Control of Electron Current by Three-Electrode Crystal. R. Hilsch and R. W. Pohl. *Zeits. f. Physik,* 111. 5–6. *pp.* 399–408, 1938.—A model of a blocking layer is made by providing a KBr crystal with two electrodes, one of which (*e.g.,* Ca) can yield electrons to the crystal but the other (*e.g.,* Pt) cannot. By virtue of electronic conduction through the crystal such an arrangement acts as a rectifier. It is considered to be analogous to a Cu_2O rectifier or to a 2-electrode thermionic valve. A corresponding model of a 3-electrode valve is made by adding a Pt grid electrode in the body of the KBr crystal. With a grid potential of + 10 V such a 3-electrode crystal controls a current of 0·4 mA with a grid current of 0·02 mA, *i.e.,* gives a 20-fold amplification. Characteristic curves are given. The arrangement is suitable for demonstration purposes, as the alteration of anode current consequent upon an alteration of grid potential can be conveniently followed by eye. L. A. W.

797. Model of Supraconductors on Electron Theory. H. Welker. *Zeits. f. techn. Physik,* 19. 12. *pp.* 606–611, 1938.—It is suggested as an extension of London's theory, that in contrast to normal conductors where the electrons are considered to be in a ground state at absolute zero in the absence of external field, in supraconductors the electrons have a minimum energy of order of magnitude $A = kT_c$, where T_c is the critical temperature and k is Boltzmann's constant. On the basis of this assumption, explanations are afforded of diamagnetic behaviour, of the linear change in electron heat, and of other properties. The value of the quenching magnetic field can be calculated for $T = 0$. F. C. C.

798. Theory of Supraconductivity. A. Papapetrou. *Zeits. f. Physik,* 111. 5–6. *pp.* 318–331, 1938.—An attempt is made to allow for the electrostatic interaction between the electrons in a conductor by substituting for each electron the average charge density of a " wave packet." R. P.

799. Magnetic and Thermodynamic Functions in the Supraconductive, Intermediate and Normal States. P. H. van Laer. *K. Onnes Lab. Leiden, Comm. Suppl. No.* 86. *Physica,* 6. *pp.* 1–16, *Jan.,* 1939. *In English.*—A survey is given of some magnetic and thermodynamic functions which are of importance in the macroscopic theory of supraconductivity. The magnetic properties, the entropy, the internal energy and the enthalpy, and the thermic potential are dealt with in succession. Diagrams are given which represent these functions in dependence on external magnetic field and temperature. AUTHOR.

800. Dependence of Specific Resistance of Platinum on Wire Diameter. L. Riedel. *Ann. d. Physik,* 33. 8. *pp.* 733–736, *Dec.,* 1938.—Measurements on Pt wires 15·7 μ in diameter show, in disagreement with the results of Reuter [see Abstract 306 (1938)], that the specific resistance at 0° C. is little different from that of the metal in bulk, an increase of less than 1% being observed. This indicates that the mean free path of the conducting electrons in Pt is of the same order of magnitude (10 to 100 $m\mu$) as that of other metals, a result which is in accord with Hamburger's deductions from measurement on thin films of condensed metal [see Abstract 191 (1932)]. R. W. P.

801. Electrical Conductivity and Diffusion in Semi-Metallic Alloys. Part III. $Cu_{2-x}Te$. H. Reinhold and H. Bräuninger. *Zeits. f. phys. Chem.* 41. *Abt.B.* 6. *pp.* 397–426, 1938.—The specific conductivity of the semi-metallic alloys of composition $Cu_{1\cdot95}Te$, $Cu_{1\cdot87}Te$, $Cu_{1\cdot80}Te$ and $Cu_{1\cdot71}Te$ was determined in the range 400° to − 180° with particular reference to the previous heat treatment of the alloy. It is of the order $10^3 - 10^4$ ohm^{-1} cm^{-1}. The transition temperatures $\alpha \rightleftharpoons \beta$-$Cu_{2-x}Te$ and $\beta \rightleftharpoons \gamma$-$Cu_{2-x}Te$ were found to be 360° and 320°, respectively. The thermoelectric power of the couple $Pt/Cu_{2-x}Te$ was determined over the range 100° to − 150° and its variation with the previous heat treatment of the alloys is discussed. The diffusion constants in the region of existence of the three enantiotropic phases of the alloys were determined. Unlike the conductivity, the diffusion constants are not appreciably affected by previous heat treatment. The electrolytic transport numbers of the alloys of composition $Cu_{1\cdot85}Te$ and $Cu_{1\cdot77}Te$ were determined at 410° (α-$Cu_{2-x}Te$) and at 335° (β-$Cu_{2-x}Te$). They are approximately 10^{-4}. The results are discussed on the basis of the theory of Wagner and Schottky. [See Abstract 308 (1938).] A. J. M.

802. Conductivities of Electrolytes in Anhydrous Acetic Acid. B. V. Weidner, A. W. Hutchison and G. C. Chandlee. *Am. Chem. Soc., J.* 60. *pp.* 2877–2879, *Dec.,* 1938.—The specific conductances of a number of uni-univalent electrolytes have been determined in dilute solutions in acetic acid with a specific conductivity varying from 0·37 to $0{\cdot}70 \times 10^{-8}$ mho at 25°. AUTHORS.

803. Electrolytic Conductivity of $ZnSO_4$ and $CuSO_4$ in Water. B. B. Owen and R. W. Gurry. *Am. Chem. Soc., J.* 60. *pp.* 3074–3078, *Dec.,* 1938.—The specific conductivities and pH values of dilute $ZnSO_4$ and $CuSO_4$ solutions were measured at 25°. The results were corrected for hydrolysis, and the equivalent conductances of the hypothetical unhydrolysed salts reported at even values of $\sqrt{C}$. The limiting equivalent conductances and "ionisation constants" of the salts were estimated by several procedures based upon the interionic attraction theory and the law of mass action. The dependence of the results upon the nature of the extrapolation function is discussed, and $\Lambda_0 = 132 \cdot 8$, $K = 0 \cdot 0049$ for $ZnSO_4$, and $\Lambda_0 = 133 \cdot 6$, $K = 0 \cdot 0043$ for $CuSO_4$ are proposed as the most reliable values. AUTHORS.

804. Electronic Conduction in Insulating Crystals under Very High Field Strength. A. v. Hippel. *Phys. Rev.* 54. *pp.* 1096–1102, *Dec.* 15, 1938.—After a short discussion of electronic conduction in insulators with the main emphasis placed on the electrostatic coupling between electron and lattice, new experimental results are given: Current-voltage characteristics and photoelectric response have been measured in single crystals up to the breakdown point. 10^7 V/cm. have been reached in mica, and phenomena have been observed acoustically, making a crystalline type of light-counter feasible. The dark-currents and photocurrents observed give information about the mechanism of electric conduction under very high field strength. AUTHOR.

805. Electric Currents and Counter-E.M.F.'s in Paraffin Wax Subjected to X-Rays. W. Ścisłowski. *Acta Physica Polonica,* 7. 2. *pp.* 127–158, 1938. *In German.*—Using the electrometer method previously described [see Abstract 2983 (1938)] investigation was made of the currents and counter e.m.f.'s in samples of paraffin wax subjected to X-rays. It was found that the results were similar to those obtained using γ-radiation, though initially an appreciably greater current increase occurred. A special method was employed to carry out direct measurements of the conduction currents in paraffin wax subjected to radiation and it was found that the complex behaviour of the current-time and current-potential characteristics can be accounted for by the simultaneous occurrence of conduction and residual currents with fundamentally different properties. A. W.

806. Simultaneous Determination of Resistances, Currents and E.M.F. in Absolute Units, Ohms, Amperes and Volts. A. Guillet. *Comptes Rendus,* 207. *pp.* 1032–1034, *Nov.* 28, 1938.—A detailed survey and enumeration of the dispositions of apparatus, technique, conditions and subsidiary factors and considerations bearing on precision measurements. N. M. B.

See also Abstracts 826, 844, 862.

DIELECTRICS AND CAPACITANCE.

807. Hindered Molecular Rotation and Dielectric Behaviour of Condensed Phases. A. H. White. *J. Chem. Phys.* 7. *pp.* 58–60, *Jan.,* 1939.—The polarisability of a liquid or a collection of randomly oriented single crystals in which polar molecules are unable to move except to rotate from one to the other of two equilibrium orientations separated by an angle β and of potential energies whose difference is E, is $a = (\mu^2/6kT)(1 - \cos\beta)/\cosh^2 E/2kT$, where μ is dipole moment. This model accounts for the reduction of α in solids and liquids from the value $\mu^2/3kT$ observed in gases, and at the same time provides for anomalous dispersion in terms of discontinuous molecular processes. AUTHOR.

808. Dielectric Absorption and Dielectric Constant of Solutions of Aliphatic Amino Acids. H. Fricke and A. Parts. *J. Phys. Chem.* 42. *pp.* 1171–1185, *Dec.*, 1938.—Measurements, at frequencies up to 65·6 Mc./sec., are given of the dielectric absorption and dielectric constant of different concentrations of solutions of glycine, alanine, α-aminobutyric acid, α-aminocaproic acid, γ-aminobutyric acid and ϵ-aminocaproic acid. The electrolytic cell containing the amino acid is balanced in a resonance circuit against a similar cell, containing a KCl solution, and a parallel condenser. The errors of the method are discussed in some detail. The relation of dielectric constant to molar concentration is approximately linear, showing a slight decrease in slope with increasing concentration. In the range of frequencies used, the dielectric absorption (represented by the equivalent electric conductance) increases as the square of the frequency. The relation of dielectric absorption to concentration shows increasing slope with increasing concentration in direct proportion to the change of the viscosity of the solutions with concentration. The results indicate that the relation of polarising electric force to average electric force in the solutions is approximately independent of the degree of polarisation. On this assumption and otherwise following Debye's theory of anomalous dispersion, values of the volume of the amino acid molecules are derived which are somewhat lower than the true volumes. The molecular volumes obtained from the dielectric measurements are closer to the true volumes than those obtained by using Stokes' law to calculate the electric conductance of the amino acid ions. Measurements are also given of the viscosities of the solutions used and of the dielectric absorption of water. AUTHORS.

809. Apparent Dipole Moment of Hexamethylenetetramine in Chloroform Solution. R. J. W. le Fèvre and G. J. Rayner. *Chem. Soc., J. pp.* 1921–1925, *Dec.*, 1938.—Although Duden and Scharff's formula (1895) for $(CH_2)_6N_4$—in which the four N atoms are situated at the apices of a regular tetrahedron—has been shown to be compatible with X-ray examinations of the *solid* (Gonell and Mark; Dickinson and Raymond; 1923) and with electron-diffraction studies of the *vapour* [see Abstract 3888 (1938)], it is not reconciled easily with many of the chemical reactions of this substance in *solution*. Dipole-moment measurements now described suggest that the tetramine molecule dissolved in chloroform is non-polar, and therefore has a symmetrical structure. Some physical evidence is thus provided permitting the Duden-Scharff model for the dissolved state, as well as the solid and the gaseous. Raman displacements are recorded for solutions of hexamine in both water and chloroform. AUTHORS.

810. Dipole Moment of Free Molecule from Data of Pure Dipole Liquid. C. J. F. Böttcher. *Physica*, 6. *pp.* 59–81, *Jan.*, 1939. *In English.*—Onsager derived a formula suitable for calculating dipole moment from the dielectric constant and the index of refraction of the undiluted dipole liquid: $\mu^2 = \frac{9kT}{4\pi N} \cdot \frac{(\epsilon - n^2)(2\epsilon + n^2)}{\epsilon (n^2 + 2)^2}$, where μ = the dipole moment of the free molecule, n = the index of refraction for $\lambda \to \infty$, ϵ = the dielectric constant, N = the number of molecules per cc., hence $N = 6{\cdot}06 \times 10^{23} . d/M$. It is shown that moments found by means of this formula are sufficiently independent of temperature and in good agreement with values determined in gases and dilute solutions except with associating compounds (water, alcohols, acids) and in case the dipole moment is changed by mechanical interaction of the molecules (ethers, ethylene-chloride). Indeed these exceptions were to be expected, because the suppositions of Onsager's theory are not correct in this case. For compounds with large ϵ the method proves to be better even than determining μ in dilute solutions. For some halogen compounds moments which are somewhat too low are found. The method seems to be recommendable especially for compounds with $\mu < 1$. Here the other methods are so inaccurate that data of the pure liquid should preferably be used. AUTHOR.

***811. Commutator for Comparison of Capacitances. D. S. Ainslie.** *Am. Phys. Teacher,* 6. *pp.* 325–326, *Dec.,* 1938.—A detailed description is given of a special rotating commutator by means of which the condensers to be compared are repeatedly charged and then discharged through a galvanometer, equality of charge being obtained by adjustment of a potentiometer and indicated by zero deflection on the galvanometer. Increased sensitivity and reduced effects of absorbed charges are given by the use of the commutator as compared with the usual double-pole change-over switch. C. E. W.

ELECTROCHEMISTRY.

812. Dissociation in Sulphuric Acid with Temperature. P. Koteswaram. *Indian Journ. Phys.* 12. *pp.* 299–304, *Nov.,* 1938.—The effect of temperature on H_2SO_4 is studied with the aid of Raman effect. As in the case of dilution, shifts are observed in the lines 558, 928 and a definite increase in intensity is noticed in the 1050 line which is attributed to the HSO_4 ion. The similarity in the changes produced by dilution and temperature is interpreted as due to the progressive dissociation of the acid even with temperature into HSO_4 and SO_4 ions. That the strong continuum usually observed in the Raman spectrum of H_2SO_4 can be removed by heating it with $KMnO_4$, $K_2Cr_2O_7$, or a trace of HNO_3, or even by heating to about 200° C., is pointed out. AUTHOR.

813. Equation for Mean Ionic Activity Coefficient of Electrolyte in Water, and Revision of Dissociation Constants of Sulphates. C. W. Davies. *Chem. Soc., J. pp.* 2093–2098, *Dec.,* 1938.—An empirical extension of the Debye-Hückel limiting activity equation is proposed. A survey of all the available data for electrolytes in water at 25° shows that the equation is in good agreement with the actual values of the mean ionic activity coefficient in dilute solutions, the average deviation being about 2% in $0 \cdot 1$ *M*-solution and proportionately less at lower concentrations. The equation is applied to the activity data for $ZnSO_4$ and $CdSO_4$, and dissociation constants are derived for these salts which agree with the values obtained from conductivity measurements. AUTHOR.

814. Glow-Discharge Electrolysis. Part IX. A. Klemenc and G. Heinrich. *Zeits. f. phys. Chem.* 183. *Abt.A.* 3. *pp.* 217–232, 1938.—The apolar generation of electrolytic gas $(2H_2 + O_2)$ in glow-discharge electrolysis [see Abstract 3824 (1938)] is further investigated. The mechanism involves the formation of metastable molecules of not too short lifetime, and of the species considered the excited H_2O molecule is the one which accords most closely with the observed facts. By using a spherical vessel filled to different levels with electrolyte, the effect of the distance of the wall from the glowing spot is investigated. The results are in good qualitative agreement with the deductions from a theoretical treatment of the diffusion of the metastable molecules to the wall, where they decompose into electrolytic gas. L. A. W.

815. Transference Numbers of Lanthanum Chloride. L. G. Longsworth and D. A. MacInnes. *Am. Chem. Soc., J.* 60. *pp.* 3070–3074, *Dec.*, 1938.—Measurements of the transference numbers at 25° of aqueous solutions of $LaCl_3$ by the method of moving boundaries have been made. The chloride ion conductances of these solutions have been compared with similar measurements of solutions of $CaCl_2$ and NaCl. From this comparison an empirical rule for the effect of the valence of the co-ion on the chloride ion conductance has been obtained. AUTHORS.

816. Electrochemistry of Corrosion of Partly Immersed Zinc. R. S. Thornhill and U. R. Evans. *Chem. Soc., J. pp.* 2109–2114, *Dec.*, 1938.—A new form of "dielectrode" has been designed for determining the distribution of kathodic and anodic areas on partly immersed metal. Zinc, if freshly washed with acid and immersed in *N*/1000-NaCl, suffers attack mainly along the "meniscus foot"; the meniscus zone remains immune from corrosion for at least two weeks—provided evaporation and disturbance be avoided. Electrical measurements show (*a*) that all places where corrosion can be observed to be occurring are definitely anodic, suggesting that corrosion is wholly electrochemical, (*b*) that the kathodic reaction occurs almost entirely at the meniscus head—the place to which O_2, a stimulator of the kathodic reaction, can be supplied most readily. Places in the lower part of the specimen which escape serious corrosion are not kathodic but neutral. Although in the present work the corrosion seems to be essentially connected with differential aeration currents, that should not be taken to mean that differential aeration is the sole cause of corrosion; many types of attack are known where this factor is entirely unimportant. [See Abstract 2992 (1938).] AUTHORS.

817. Electrolytic Overvoltage. M. Lemarchands and W. Juda. *Comptes Rendus*, 207. *pp.* 1192–1194, *Dec.*, 1938.—Assuming that the passage of a current through an electrolyte creates a "vacuum" of ions in the immediate neighbourhood of the electrodes, which gives rise to and maintains a potential at the electrode, an expression connecting the potential of the electrode, the initial concentration of the electrolyte, and the current density is obtained. The relationship is in good agreement with experiment. A. J. M.

***818. Differential Titrations with Tungsten Electrodes. C. T. Abichandani and S. K. K. Jatkar.** *Indian Inst. of Science, J.* 21*A*. 30. *pp.* 363–367, 1938.—The electrodes are of W wire, one being inserted in a medicine dropper, the other dipping directly in the solution, and a simple thermionic valve used for measurements. The arrangement is figured diagrammatically and the curves obtained with oxalic, malonic, succinic, adipic and formic acids are given as examples. C. A. S.

***819. Automatic Potentiometric Titration Apparatus. C. T. Abichandani and S. K. K. Jatkar.** *Indian Inst. of Science, J.* 21*A*. 31. *pp.* 369–371, 1938.—The method is described and the apparatus figured with example of the curve obtained. C. A. S.

820. Sb Electrode in pH Measurements. K. Fischbeck and F. Eimer. *Zeits. f. Elektrochem.* 44. *pp.* 845–856, *Dec.*, 1938.—The behaviour of the Sb electrode for pH measurements was investigated. The potential was measured in a number of solutions of different acids. The influence of temperature, of velocity of streaming, and of the addition of oxidising and reducing reagents were studied. The results indicated that the electrode is a very convenient means of measuring pH values under specific conditions, but the oxidation-reduction potential of the solutions measured must be considered. F. J. B.

821. Thermodynamics of Double Electrodes with Restrained Ionic Transference in the Currentless State. E. Lange and K. Nagel. *Zeits. f. Elektrochem.* 44. *pp.* 856–870, *Dec.*, 1938.—The paper is a theoretical treatment of the thermodynamics of the double electrode, and a continuation of previous work [see Abstract 410 (1937)]. F. J. B.

822. Periodic Variations of Tin Potential in CrO_3-HCl Solutions. M. Karschulin and G. Ehrensvärd. *Zeits. f. Elektrochem.* 44. *pp.* 877–881, *Dec.*, 1938.—The tin electrode immersed in solution of CrO_3 in HCl, of suitable concentrations, showed a periodic variation of potential when measured against a calomel electrode. The tin passed into solution periodically. The dependence of the potential of tin in *N* HCl on the chromic acid concentration was measured. The extent of the potential oscillation, the frequency and the amplitude were determined. Photographic records of the potential oscillations were obtained. It is considered that the results indicate the formation of a chloro-complex of tin, $HSnCl_3$, which brings about the periodic changes. F. J. B.

823. Streaming of Electrolytes in Reduction at the Hg Drop Electrode. Parts I and II. H. J. Antweiler. *Zeits. f. Elektrochem.* 44. *pp.* 888–908, *Dec.*, 1938.—Earlier work [see Abstract 411 (1939)] is continued. Observations were made on the relationship between the nature and concentration of the kations and the form of the current strength-voltage and time curves. The phenomena were studied for Cu, Fe, Hg, Ni, Mn, Zn and Ca ions. The current strength-time curves for the single drops were registered by a Siemens amplifier electrocardiograph. The streaming was recorded photographically. The results indicated that when there was no double layer present (either at the electrocapillary zero or by the adsorption of an electroneutral molecule) no streaming took place. F. J. B.

824. Maxima on Current-Voltage Curves. B. Bruns, A. Frumkin, S. Jofa, L. Vanjukova and S. Zolotarewskaja. *Acta Physicochimica*, 9. 2. *pp.* 359–372, 1938. *In English*—A theory of the maximum of current-voltage curves is outlined, which is based mainly on experiments carried out with large Hg kathodes and with solidified mercury. This theory explains the appearance of maximum by the " auto-stirring " caused by the movements of the Hg surface. These movements are related to local difference of interfacial tension or to variations of interfacial tension with time and it is shown that these movements must be most pronounced under definite conditions of polarisation. The decrease of the auto-stirring when polarisation exceeds a certain limit might be caused by the beginning of a second electrolytic process or by a less favourable distribution of surface tension differences on the surface or by an increase of the damping action of the surface charge. AUTHORS.

825. Rapid Method for Traces of Metals by the Dropping Mercury Electrode. R. H. Müller and J. F. Petras. *Am. Chem. Soc., J.* 60. *pp.* 2990–2993, *Dec.*, 1938.—Current-potential curves may be obtained from the dropping Hg electrode with very simple equipment. The marked symmetry of these curves suggests a simple increment method in which the change in current is noted for two applied potentials more or less equidistant from the characteristic *Halbwellen* potential. The current increments are a linear function of the concentration of the given ion.

The presence of other ions does not interfere with this relationship to any greater extent than it does with conventional polarographic methods. The method is illustrated with Pb, Zn and Cd ions, and pairs of these in neutral and alkaline solution. AUTHORS.

826. Effect of Experimental Conditions, especially Temperature, on Resistance of Glass Electrodes. H. Saechtling with H. Richter and H. G. Rosenthal. *Zeits. f. Elektrochem.* 45. *pp.* 79–82, *Jan.*, 1939.—Measurements show that the electrical resistance of glass electrodes varies much more rapidly with temperature than does the resistance of metals or electrolytes. An approximately exponential law is followed. Detailed results are given for a particular Jena glass. L. A. W.

See also Abstracts 552, 771.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

827. Gyroscopic Model of Electron and Application to Radiation Probability of Electron-Positron Pairs. H. Hönl. *Ann. d. Physik*, 33. 7. *pp.* 565–583, *Dec.*, 1938.—Two models of the electron are proposed. In the first the electron (or positron) is assumed to consist of a space filled with a continuous distribution of charge and rotating about an axis, the equatorial velocity being equal to that of light. Since the electron must have a spin moment of the order of $\frac{1}{2}$, the radius must be of the order of magnitude $a_0 = h/mc$ and hence is comparable with the Compton wavelength $\lambda_0 = 2\pi a_0$. The rotational energy is approximately mc^2 and the magnetic moment of the order of magnitude of a Bohr magneton. The second model assumes a macroscopic stationary electron (or positron) with a " mass point," at a distance $a = h/2mc$, rotating round it with the velocity of light. The impulse moment is then accurately $\frac{1}{2}h$, the rotational energy accurately mc^2 and the magnetic moment, apart from a factor 2, in agreement with that of Bohr's magneton. Discussion of the two models shows that the second has certain advantages. It is also shown that the disintegration probability of electron-positron pairs is in agreement, as regards the order of magnitude, with a formula first deduced by Fermi and Uhlenbeck from the Dirac theory. A. W.

828. Mass Variability of Very Rapid Electrons. H. Lahaye. *Ann. d. Physik*, 34. 1. *pp.* 60–76, *Jan.*, 1939.—Using Kaufmann's method of simultaneous electric and magnetic deflection of the β-rays from a Ra preparation and applying the relative method of Starke of comparison with kathode rays deflected in the same apparatus, measurements were made of the variability of the mass of electrons for the velocity range from $0 \cdot 698$ to $0 \cdot 888c$. The results obtained agree very closely with the values given by the Lorentz formula. A. W.

829. Motion of Electrified Particle in Field of a Magnetic Dipole. Part I. L. Gialanella. *Accad. Lincei, Atti*, 28. *pp.* 14–22, *July*, 1938.—The problem of the motion of a charged particle in the field of two equal and opposite magnetic poles, placed a finite distance apart, is treated in the special case in which the trajectory of the particle remains close to the line through the two poles. In this case it is possible to find a second integral of the equations of motion (besides the energy) and reduce them to equations of first order. R. P.

830. Relativistic Electron in Crossed Fields. H. Ott. *Ann. d. Physik*, 33. 7. *pp.* 584–590, *Dec.*, 1938.—In crossed electric and magnetic fields a charged particle, according to classical mechanics, performs a cycloidal motion perpendicular to the lines of magnetic force. For such motion, calculation is here made of the relativistic path correction and the possibility of testing experimentally the results of these calculations is briefly discussed. A. W.

831. Motion of an Electrified Particle in Superposed Electric and Magnetic Fields. T. Boggio. *Comptes Rendus*, 207. *pp.* 1189–1190, *Dec.* 12, 1938.—Assuming that the electric and magnetic fields are symmetrical with respect to the z-axis, so that the potential functions only depend on the distances of the point in question from the z-axis and from a plane normal to the z-axis at some reference point O, expressions are derived for the potential functions depending on the Legendre polynomial $P_{m-1}(\cos\theta_s)$. The corresponding integrals have recently been established by the author and Agostinelli. A. W.

832. Experimental Investigation of de Broglie's Equation. J. G. Tappert. *Phys. Rev.* 54. *pp.* 1085–1088, *Dec.* 15, 1938.—The validity of de Broglie's equation is checked experimentally for electrons of 24 to 64 ekV energy. The experiment consists essentially of deflecting a beam of kathode rays by an electrostatic field and, keeping the deflection constant, determining the relation between the intensity of the deflecting field, V, and the de Broglie wave-length, λ, of the deflected electrons. On the assumption that the motion of the electrons is in accordance with the laws of relativistic mechanics, and that the de Broglie wave-length is inversely proportional to the momentum, it is shown theoretically that the expression $\lambda^2 V(1 + h^2/m_0{}^2c^2\lambda^2)^{\frac{1}{2}}$ should be independent of λ. Within the limits of experimental error this expression is found to be independent of λ, thereby demonstrating that the de Broglie equation, $\lambda = h/mv$, combined with the relativity expression for m, is adequate to describe the facts. AUTHOR.

833. Electron Interference. H. Boochs. *Zeits. f. techn. Physik*, 19. 12. *p.* 605, 1938.—An electron diffraction camera is used to measure the energy loss of electrons of about 50 ekV energy when they traverse thin foils of Al and mica. The lattice constants of small crystals of Ni are also determined. F. C. C.

834. Effect of Thermal Agitation on Intensity of Reflection of Kathode Rays from Crystals. D. Coster and P. G. van Zanten. *Physica*, 6. *pp.* 17–26, *Jan.*, 1939. *In English.*—A method is described which demonstrates the influence of temperature on the intensity of kathode-ray reflection. In provisional measurements the Debye-temperature of gold is found to be 160° K. AUTHORS.

835. Scattering of Slow Electrons in, and Apparent Electron Affinity of BF_3. R. P. Seward and J. H. Simons. *J. Chem. Phys.* 7. *pp.* 2–3, *Jan.*, 1939.—Slow electron scattering in BF_3 exhibits a phenomenon similar to that observed in Hg. An inverse fourth power attraction law is indicated and the apparent electron affinity may be roughly estimated. A possible correlation between electron affinity and bands observed in the spectra [see Abstract 2108 (1935)] is postulated. AUTHORS.

836. Electronic Waves. J. J. Thomson. *Phil. Mag.* 27. *pp.* 1–32, *Jan.*, 1939.—The experiments made on electronic waves have shown that if u is the velocity of the electron in the direction in which it is travelling and λ the wave-length of the electronic wave $u\lambda$ is constant and equal to $2\pi c^2/p$ where p is the frequency of the electronic wave; it follows from this equation that all electronic waves have the same frequency and

naturally suggests that this is the frequency of the electronic spin, and that this is $1\cdot 2 \times 10^{20}$. Though u is in general very much smaller than the velocity of light, yet the wave and the electron keep in touch with each other; to do this the wave must pursue a very circuitous path. The case when this path is a regular helix is worked out. The velocity of the wave along the path of the spiral is $c \cos \alpha$; if this equals u the two will keep together. It is shown that the electron does not lose energy by radiation as it travels through space. A large number of experiments have been made on the loss of energy by collisions between kathode rays and the gas through which they are passing, using the parabolic method of crossed electric and magnetic fields. Since all the electrons have the same mass there is only one parabola, and if they all had the same speed there would only be one point; but if the electron loses speed by an abrupt collision there will be another spot, if it made two there would be three, and so on. The collision and the changes produced in velocity are registered on the photographic plate. It was found that the changes of velocity were due to the ionisation of the gas by collisions and that the energy loss was measured by the ionising potential of the gas. This is in good accord with the experiment. A most important point is that it is not an isolated spectrum; it is a series spectrum. The lines are not independent; each is a part of a whole, and is accompanied by a number of others whose frequencies form a Balmer-like series with the same difference between neighbours. In order to keep in equilibrium with its surroundings an electron must have the energy possessed by one whose frequency is that of the spinning electron. There is a continuous supply of energy of this frequency and of no other. When things are in a steady state each electron will have bound to it this amount of energy in the ether.
AUTHOR.

837. Neutron-Proton Scattering. K. C. Kar and D. Basu. *Phil. Mag.* 27. *pp.* 76–83, *Jan.* 1939.—This paper begins with a discussion of the problem of neutron-proton combinaton to form deuterons. The interaction potential is important in both this problem and in the problem of neutron-proton scattering. In discussing the binding energy of the deuteron the form $V = -V_0e^{-\alpha r}$ is taken for the potential, and the wave equation for the deuteron in the ground state is found to reduce to the Bessel equation, and thus the values of the parameters V_0 and α can be obtained. In the scattering of neutrons by protons, an expression is obtained for the critical distance of approach of the incident neutrons, and the analysis shows that to a first approximation the scattering is spherically symmetrical when referred to the centre of mass as origin, while the relative intensity is also independent of the velocity of the incident neutrons. A second approximation produces the result that the intensity of scattering firstly decreases with increasing angle and then increases again at large angles. Other workers have found experimental confirmation of this result.
G. O. B.

***838. Electron Microscope. L. C. Martin.** *Nature*, 142. *pp.* 1062–1065, *Dec.* 17, 1938.—Recent progress in the field of electron microscopy is briefly reviewed. The difficulties to be overcome before further progress is possible are then discussed. These are (1) scattering of the electron beam by the specimen and its support, (2) the difficulty of making achromatic electron lenses, (3) inhomogeneity in the electron beam caused by voltage fluctuations in the h.v. supply and defects of the lenses such as spherical aberration and the lack of symmetry between the geometrical and magnetic axes. Future possibilities of the method are suggested. H. J. H. S.

839. Errors in Electrical and Magnetic Deflecting Systems. W. Glaser. *Zeits. f. Physik*, **111.** 5–6. *pp.* 357–372, 1938.—In a kathode-ray oscillograph, the deflection should be strictly proportional to the deflecting potential or current and the spot should not alter in shape when deflected. In practice, errors are observed when the deflection is large. These errors are examined theoretically and it is found that the former increases with the 3rd power of the angular deflection whilst the latter has two components corresponding to coma and astigmatism, each of which causes alteration in the shape of the spot. The magnitude of the coma term is proportional to the deflection and to (aperture)^2 whilst the astigmatism term is proportional to aperture and (deflection)^2. H. J. H. S.

See also Abstracts 537, 668, 722, 781, 785, 863 and
274B. Transverse Control of a Kathode Ray. H. E. Hollmann.
276B. Dynamic Ballistics in the Kathode-Ray Tube. H. E. Hollmann.
337B. Production and Use of Neutrons. F. A. Heyn.

ELECTROSTATICS.

See Abstracts 568, 655, 872.

MAGNETISM AND ELECTROMAGNETISM.

840. Electrodynamics of Material Media. C. Eckart. *Phys. Rev.* **54.** *pp.* 920–923, *Dec.* 1, 1938.—The equations of a classical and gauge-invariant theory of electrodynamics are developed on the basis of a variational method together with Maxwell's equation. The medium envisaged is composed of electrical particles capable of existing in a finite number of states. The assembly of particles is characterised by the number of particles in each state, their average velocity and a scalar function of position analogous to the velocity potential of the irrotational motion of a fluid. An adequate theory of dispersion results from the method developed. G. C. McV.

841. Theory of Ideal Magnetisation Curve. F. Sauter. *Ann. d. Physik*, **33.** 7. *pp.* 672–681, *Dec.*, 1938.—The Heisenberg theory may be made to give the formulæ of the classical Weiss theory by expressing the relation between the exchange integral A and the Weiss field factor *f* in a suitable manner. A modified classical theory is expounded which gives values in agreement with experiment except for a small region in the neighbourhood of the Curie point. H. J. H. S.

842. Flux and Magnetic Moment of a Magnet. F. W. Warburton. *Am. Phys. Teacher*, **6.** *pp.* 326–328, *Dec.*, 1938.—Gives a theory of the measurement of flux and magnetic moment in a permanent magnet in terms of amperian currents equivalent to the electronic currents in the atoms, and shows the superiority of this conception to one based on fictitious magnet poles. A modified method of determining the flux distribution of a magnet, in which the search-coil is moved in a succession of short steps, is described and is shown to obviate an error in the determination of the magnetic moment liable to occur when large displacements are employed. C. E. W.

843. Activation and Composition of Elementary Moment in Ferromagnetic Alloys. R. Forrer. *Comptes Rendus*, **207.** *pp.* 1091–1094, *Dec.* 5, 1938.—From curves obtained by plotting the atomic moments of Fe-Co, Ni-Co and Fe-Ni alloys, expressed in Weiss magnetons, as a function of the atomic number, a new conception of the atomic moment is developed ; it consists of two parts, (i) the basic moment due to the spin of electrons and measured by 1 Bohr magneton per single electron, and (ii) a supplementary moment varying between a high and a low limit, with a maximum value of 1 Weiss magneton for a spin moment of 1 Bohr magneton. The nature of (ii) and the significance of the Weiss magneton are discussed. W. R. A.

844. Curie Points and Electrical Resistance. H. Bittel and W. Gerlach. *Ann. d. Physik*, 33. 7. *pp*. 661–671, *Dec.*, 1938.—Electrical measurements on Ni near the Curie point show that the temperature coefficient curve has a sharp kink whilst the resistance-temperature curve has only a small change in curvature. The kink corresponds accurately to the Curie point measured magnetically in the case of very pure Ni whilst for impure Ni or for its alloys the kink corresponds to a lower temperature than the Curie point measured magnetically. H. J. H. S.

845. Magnetisation of Ferromagnetic Colloids. W. C. Elmore. *Phys. Rev.* 54. *pp*. 1092–1095, *Dec.* 15, 1938.—The magnetisation curves of colloidal magnetite (Fe_3O_4) and colloidal siderac ($\gamma - Fe_2O_3$) have been determined by a null method for fields from 0 to 400 gauss. The measured curves have been found to agree with a theoretical curve based on the following assumptions : (1) Each colloid particle is a permanent magnet. This assumption is in accord with a prediction of the theory of ferromagnetism that small ferromagnetic particles be single magnetic domains. (2) There exists a distribution in the size of the particle moments similar to the weight distributions which have been found for other colloids. (3) The particles behave as the molecules of a classical paramagnetic gas. On this basis the average particle moment is found to be $5 \cdot 2(10)^{-16}$ for the magnetite sol and $7 \cdot 4(10)^{-16}$ for the siderac sol. Several other quantities related to the colloids are briefly discussed. AUTHOR.

846. Spin-Lattice Equilibrium in Cæsium-Titanium-Alum at Low Temperatures. W. J. de Haas and F. K. du Pré. *K. Onnes Lab. Leiden, Comm. No.* 253*c*. *Physica*, 5. *pp*. 969–970, *Dec.*, 1938. *In English.*—The relative susceptibilities of Cs-Ti-alum at low temperatures were determined by a mutual inductance bridge. Curie's law was found to be valid from $4 \cdot 2°$ K down to $1 \cdot 2°$ K. Similar measurements made with $Fe\text{-}NH_4$-alum show that the susceptibility found for the first mentioned alum is of the right order of magnitude. No decrease of susceptibility took place under an external constant field of 2000 gauss parallel to the alternating field, and the relaxation time for the spin-lattice equilibrium is computed as less than 10^{-3} sec., even at $1 \cdot 2°$ K, or less than a twentieth of that found for $Fe\text{-}NH_4$-alum under the same conditions. G. E. A.

847. Paramagnetic Absorption in Iron-Ammonium-Alum in a Constant Parallel Field. F. Brons and C. J. Gorter. *Physica*, 5. *pp*. 999–1008, *Dec.*, 1938. *In English.*—$Fe\text{-}NH_4$-alum shows strong paramagnetic absorption at liquid-air temperatures and at frequencies of about 10^6 if a strong parallel magnetic field is applied. The effect is studied for different values of temperature, frequency and field, and the results are given in curves and by means of formulæ. Although these formulæ agree with those derived by Casimir and Dupré, the experiments are not considered as confirming the latter's theory. [See also Abstract 380 (1937).] G. E. A.

848. Apparent Absence of Paramagnetic Dispersion and Absorption in Titanium-Cæsium-Alum. C. J. Gorter, P. Teunissen and L. J. Dijkstra. *Physica*, 5. *pp.* 1013–1017, *Dec.*, 1938. *In English.*—The region of paramagnetic dispersion and absorption for Fe and Cr alums lies at frequencies of the order of 10^6 if a strong parallel magnetic field is applied. In Ti alum at the temperature of liquid N_2 the paramagnetic dispersion and absorption are very small. The constant of relaxation is less than 1/100th of that for Fe alum, although theory points to its being greater than the value for Fe alum. This result is unexpected.

G. E. A.

849. Mechanism of Paramagnetic Relaxation. R. de L. Kronig. *Physica*, 6. *pp.* 33–43, *Jan.*, 1939. *In English.*—Mathematical. Measurements on the paramagnetic relaxation in Cs-Ti alum at liquid-air and liquid-He temperatures have shown that there is no suppression of paramagnetic susceptibility or increase of energy absorption in alternating magnetic fields when a constant magnetic field of the order of 1000 Oe. is applied. This is contrary to the behaviour of NH_4-Fe alum and K-Cr alum. The theory of Waller does not hold for Cs-Ti alum and a new effect, involving coupling of spins to the orbital motion, is postulated. When the lattice vibrates the orbital motion undergoes periodic changes due to the variations in the electric field of the crystal and causes the spins to alter their orientation with respect to the constant external magnetic field. The magnitude of this effect depends essentially on the energy separation of the ground state of orbital motion for the magnetic ion in the crystalline field from its excited states. Consideration of the ions Ti^{+3}, Cr^{+3} and Fe^{+3} leads to the conclusion that this new effect is much more important in Ti alum than in the others. **Errata,** *ibid. p.* 240, *Feb.*, 1939. W. R. A.

See also Abstract 627.

MEDICAL RADIOLOGY AND ELECTROLOGY.

850. Specific Attraction between Gene Molecules. P. Jordan. *Phys. Zeits.* 39. *pp.* 711–714, *Oct.* 15, 1938.—The process of conjugation of homologous chromosomes has been considered by various authors by the assumption of a small range specific attraction between homogenous gene molecules. In polymerisation and crystallisation processes, relatively simple molecules, *e.g.*, of cellulose, combine together by valence and van der Waals-London forces. However, with virus and gene molecules the process of self-doubling is very difficult to understand without the assumption of a specific attraction. The supposition that there is a kind of attraction which applies only to very large molecules arises from the results of serological and biochemical experiments. A group of cells having a homogenous nutrition ratio can show a considerable difference in their life cycle between origin and reproductive division. It must be assumed that the genes are doubled with the cells and that they also show a similar diversity of life cycle. In B.coli there may be as many as 70 structure units which contain genes. From the consideration of the radiation-sensitive volume of this type [see Abstract 3033 (1938)] it seems that an even greater structure unit of approximately 10 per gene must be considered. In Section II of the present paper the author discusses on a quantum-mechanical basis the specific attraction in which two similar anharmonic oscillators are considered to be coupled through their dipole moments using the treatment of Heisenberg. It is calculated that there will be a repulsion of the symmetrical and an attraction for the antisymmetrical term. Allowance must be made for the thermal movements of the molecule. The assumption of a rigid model such as that of a diatom, for the gene or virus molecule is considered to be untenable, and the gene must be in a quasi-fluid state. It is pointed out that the discussion of the gene molecule is very incomplete in view of the lack of more definite information of its physical properties. However, it seems that the doubling process of gene and virus molecules as a characteristic basic phenomena of organic life can at least be made intelligible on a quantum-mechanical basis. T. A. C.

851. Clinical Application of Ultra-Short Electrical Waves. J. Paetzold. *Radiology*, **31.** *pp.* 707–712, *Dec.*, 1938.—Although short-wave therapy using wave-lengths of 15–3 m. has proved superior to long-wave diathermy using wave-lengths of 1000–300 m. as regards depth dose, even at 6 m. the temperature stress on sub-cutaneous fatty tissue limits the dose of ultra-short wave energy that can be applied. An account is now given of some experiments to determine the conditions necessary to improve the depth dose. Tissue phantoms composed of samples of fresh beef muscle and fat contained in a vessel of trolitul, kept at body temperature 37° C. were placed in a condenser field, and the heat distribution was examined for wave-lengths between 11 m. and 25 cm. In a typical experiment, the mean heating ratio of fat to muscle was found to be of the order of 16 : 1 at a wave-length of 6 m. and only 3 : 1 at a wave-length of 1 m. The value for the heating of fatty tissue decreased from 9 to 3·8 down to 2 if the wave-length was changed from 11 m. down to 1 m. and to 25 cm. Earlier measurements [see Abstract 390 (1937)] of the conductivity in the ultra-short wave field and the determinations of Osswald [see Abstract 1837 (1937)] for the conductivity and dielectrical constants of biological substances for wave-lengths 3–12 m. furnish a quantitative basis for the frequency to be employed; the optimum is about 4 m. for fat and about 1·3 m. for muscle at about 37° C. It is concluded that, as it is still very expensive to produce energies of several hundred watts at wave-lengths of 1 m. it can only be used in cases in which routine short-wave treatment is unsatisfactory, as, *e.g.*, in massive heating of the female pelvis. T. A. C.

852. British Radiology in the Future. W. E. Schall. *Brit. J. of Radiology*, **11.** *pp.* 769–778, *Dec.*, 1938.—In therapy, until recently 200 kV was the maximum tension employed; now there are plants working at tensions up to 1000 kV and possibly 5 years' work is necessary to decide whether the clinical results are sufficiently improved to justify the vastly increased expenditure. In diagnostic work, the introduction of the rotating-anode X-ray tube has led to demands for current output from transformers of 500–1000 mA. These tubes with an effective focus 1·2 mm. square, will carry 13 kW for 1/10 sec. With average modern films, screens and developer, it is accepted practice to allow 20 mA-sec. exposure for an adult chest at 65 kVp, full-wave current and 5 feet focus-film distance. From these data the author calculates that the power output of the transformer need not necessarily be greater than 10 kW, whereas frequently 30 kW is specified with a correspondingly increased cost of the generator. It is suggested that a physical investigation should be undertaken of the factors affecting, *e.g.*, chest radiography, which makes the maximum demand on the plant; of the size of focus, focus-film distance, current, tension, exposure, speed and gradation of film, using a mechanical model of the thorax, with a view to determining the optimum conditions. T. A. C.

***853. Kineradiography by the Direct Method. M. van de Maele.** *Brit. J. of Radiology*, 11. *pp.* 804–808, *Dec.*, 1938.—Hitherto most attention has been devoted to the production of kineradiographs by the *indirect* method [see Abstract 4252 (1938)]. The author now describes his own attempts to register the images of parts of diseased organs using three different methods of *direct* kineradiography. The first apparatus uses the ordinary principle of the kinematograph with intermittent movement, the difficulties of adaptation being the large size of the film and the necessity of employing intensifying screens. Where the ordinary kinematograph unrolls 35 cm. of film per sec., 2 m. must now be employed. A double-coated film has to be unrolled up to 16 times per sec., immobilised and compressed between the intensifying screens, then these processes reversed and the film rolled upon an opposite bobbin, all in 1/32 sec. Eventually, it was found that a speed of 6 to 8 images a second was sufficient, provided that in printing the standard film each image was either doubled or trebled according to the speed of the projection apparatus. The second apparatus uses a series of ordinary radiographic films, perforated in the margin and superimposed in a grooved box. The container was progressively lowered by a system adapted to an axle, bearing first a series of dragging spindles which dragged the film between the intensifying screens. The film is then immobilised by a compressor during the exposure, then another series of extracting spindles drags it into a receiving box. This apparatus although functioning satisfactorily is heavy and massive. In the final apparatus films were used of maximum size 13 × 18 cm. and the size of the whole apparatus was reduced to 50 × 35 cm. During exposure the movements of the organ are viewed by ordinary radioscopy and the kineradiographs are taken at the opportune moment. The advantages claimed for this model are that the band of films costs less than £12, there is no excessive wear on the rotating-anode X-ray tube and the patient's skin receives less than 1/5th of an erythema dose.

T. A. C.

854. High-Speed Radiography. N. C. Beese. *Radiology*, 31. *pp.* 716–723, *Dec.*, 1938.—It is important, and difficult, to obtain sharp shadows from moving objects. This is usually done by increasing the intensity of the X-rays, and thus decreasing the time of exposure. In the ordinary way, however, this would require special apparatus, in order to be able to withstand the large tube currents. This paper describes a method by which a very rapid and very high-voltage discharge from a condenser is used to actuate the X-ray tube. Various methods of controlling the condenser discharge are described. A kathode-ray oscillograph has been used to study the transient phenomena occurring during such a discharge. A simple method of measuring the time of discharge by the use of a rotating disc is also described. The temperature of the anti-kathode must not exceed 3000° K, otherwise excessive evaporation of W or even melting will occur. G. G.

***855. Dosage of X-Rays. G. C. Trabacchi.** *Ricerca Scientifica*, 2. *pp.* 250–257, *Sept.*, 1938.—This paper describes the apparatus for the measurement of X-ray dosage, which is used in the Instituto di Sanità Pubblica. A small ionisation chamber is used to receive a pencil of X-rays, which is so small that it cannot vary appreciably in intensity along the length of it inside the chamber: a constant p.d. is applied to this ionisation chamber, the details and construction of which are described. A potential of 300 kV is applied to the X-ray tube. This potential is smoothed as much as possible by means of two condensers; the remaining fluctuations are so small as to be just measurable by the ionisation chamber. The electrode of the ionisation chamber passes through amber insulation to a unifilar Edelmann electrometer, which is used to measure charge collected by the usual null method. The difficulties of X-ray measurements and the ionometric unit used—the röntgen—are discussed. G. G.

856. Principles Governing X-Ray and Radium Therapy. H. Holthusen. *Am. J. of Roentgenology and Radium Therapy,* 40. *pp.* 497–500, *Oct.,* 1938.—Development of treatment by X-rays and Ra in different clinics and countries is discussed, with favour of individual methods. The younger generation of radiologists is in a position to compare these methods, free from prejudice. It is not possible simply to compare physically equal dosages and it is not yet determined whether the more recent use of very high voltage excitation gives more favourable results. The question of toleration to the dosage arises, this tolerance being subject to whether the dose is administered as massive or repeated fractional doses. The author gives his own observations as regards skin cancer. B. J. L.

857. Temperature Coefficient of Effect of Radiation on Proteins and Injury of Living Cell. J. H. Clark. *Am. J. of Roentgenology and Radium Therapy,* 40. *pp.* 501–508, *Oct.,* 1938.—The properties of living matter are dependent on the protein elements and the absorption of Ra energy is an important factor in radiobiology. The changes produced by radiation in proteins and amino-acids depend upon the particular protein, the electrolytes present, their H-ion concentration, wave-length, temperature of solution, etc. The present paper deals with the effect of temperature when proteins are subjected to u.v. radiation which causes coagulation in three stages, as studied with egg albumen. The effect of salts in the solution is studied with their bearing upon the lethal action of u.v. radiation on actual cells. The effect of temperature on X-ray irradiation is further discussed. When X-ray irradiation is combined with heat treatment consideration of the temperature factor is important. B. J. L.

***858. Reduction of Back-Scatter from X-Ray Beams. B. Cassen and K. E. Corrigan.** *Am. J. of Roentgenology and Radium Therapy,* 40. *pp.* 608–609, *Oct.,* 1938.—Danger to operators in radiography is due to a large extent to scattered radiation, which may be minimised by use of an absorbing screen to intercept this radiation after the necessary radiographic result has been obtained, this screen acting as a trap to the scattered radiation. In therapeutic work at high voltage (600 kV) the author has designed such a back-scatter grid trap which is placed in the ceiling above the irradiated patient. Constructional details of this grid are given. B. J. L.

859. Concrete as Protective Material against H.V. X-Rays. G. Singer, L. S. Taylor and A. L. Charlton. *Bureau of Standards, J. of Research,* 21. *pp.* 783–794, *Dec.,* 1938.—A description is given of relative X-ray transmission measurements on a group of specially prepared concrete specimens and commercial building blocks selected to sample the concrete mixes and cover the range of concrete densities in common use. It was found that the lead equivalent of any concrete was an increasing function of its mass per unit area and independent of the nature of the mix. Relations between lead equivalence, density, mass, and thickness are given, from which the thickness of concrete necessary for adequate protection can be calculated for any voltage in the voltage interval 200 to 400 kV. AUTHORS.

860. Relation between Radiation Quality Factors and Depth. A. Mutscheller. *Radiology*, 32. *pp.* 87–90, *Jan.*, 1939.—Heterogeneous radiation measured with small ionisation instruments through various absorbing thicknesses gives rise to bent, semi-logarithmic, so-called absorption curves which should be called *absorbability curves*. Depth doses measured with small ionisation instruments represent the product of intensity in the absorbing substance multiplied by the absorption coefficient in air, and are roughly proportional to therapeutic doses, but they give no indication of the relation of the dose absorbed in a deep-seated tumour and the dose absorbed in the normal tissues outside the tumour. The doses absorbed at various depths depend not only on the measured doses but principally on the slope of the semi-logarithmic absorption curve. The importance of the extent of injury to a lesion in ratio to the extent of injury to surrounding tissues as determining the quality of the therapeutic results is pointed out. Clinical results and measuring data are combined and the experimental data given reveal that the best location for satisfactory clinical results is given by x mm. $= 13 \cdot 7\, \mu/\eta$, wherein μ is the linear absorption coefficient and η is the linear heterogeneity coefficient. Reasons are suggested indicating why depth dose curves should have a minimum. AUTHOR.

861. " Tolerance Concentration " of Radon in the Atmosphere. J. Read and J. C. Mottram. *Brit. J. of Radiology*, 12. *pp.* 54–60, *Jan.*, 1939.—Reasons are given for suspecting that radon in the atmosphere may be responsible for leucopœnia among radium workers. The radon concentrations measured in air samples taken from several radium laboratories are given. Mice have been kept in very low radon concentrations, and the effects on them are described. It is suggested that 10^{-11} curie/cm^3. may be regarded as a reasonable value for the " tolerance concentration " of radon in the atmosphere. Precautions to minimise the dangers are discussed. AUTHORS.

See also Abstract 484.

OSCILLATIONS AND WAVES.

***862. Applications of Multi-Electrode Valves. W. B. Lewis.** *Journ. Sci. Instruments*, 15. *pp.* 353–360, *Nov.*, 1938.—The properties which make possible the application of the common radio receiver multi-electrode valve in scientific instruments are considered. Four applications of the pentode are (1) high gain voltage amplification, (2) current stabilisation, (3) constant voltage amplification independent of change of valve characteristics, and (4) as an adjustable impedance. The negative resistance characteristics of some multi-grid valves, and the salient characteristics of mixer valves are also discussed. R. D.

***863. Automatic Registration of Ionosphere Echoes. I. Ranzi.** *Ricerca Scientifica*, 2. *pp.* 258–271, *Sept.*, 1938.—This apparatus which is in use at the Istituto Nazionale di Geofisica seems to be very similar to that used by E. V. Appleton and his school. By means of a transmitter of which full details are given, a small pulse of oscillations obtained from a Hartley oscillator can be radiated. The frequency of this radiation can be varied between 5·5 each 10 Mc./sec. The aerial system is described, different types of aerial being used for different wave-lengths. The reflected wave is received by a superheterodyne receiver and is then made to actuate a kathode-ray oscillograph, the time base of which is synchronised with the frequency of the emission of the pulses of radiation. The image on the end of the kathode-ray tube is photographed through a narrow slit in front of the fluorescent screen. A record of the position of the reflected beam with regard to the primary beam, the frequency at which it ceases to be reflected and thus of the height of the reflecting layer can be obtained. G. G.

864. Propagation of Wave-Packets Incident Obliquely upon a Stratified Doubly-Refracting Ionosphere. H. G. Booker. *Roy. Soc., Phil. Trans.* 237*A*. *pp*. 411–451, *Sept*. 30, 1938.—A study is made of the propagation of wave-packets incident obliquely upon a slowly varying plane-stratified doubly refracting medium with a view to applying the results to the ionosphere. The magneto-ionic theory in the form given by Appleton is only suitable for investigating vertical propagation in the ionosphere. The theory is generalised so as to be capable of describing oblique propagation of a magneto-ionic component through the ionosphere without using a refractive index which depends in a complicated way upon an unknown angle of refraction. The fundamental formula of the oblique-incidence magneto-ionic theory is an algebraic quartic equation for a quantity q which depends upon the prescribed angle of incidence and which at vertical incidence becomes identical with the well-known refractive index. The four roots of the quartic equation for q correspond to the upgoing ordinary wave, the upgoing extraordinary wave, the downcoming ordinary wave and the downcoming extraordinary wave. The level in the ionosphere where individual wave-crests are moving horizontally across a characteristically polarised wave-packet is given by the condition $q = 0$, which is equivalent to putting the angle of refraction equal to $\frac{1}{2}\pi$ in Snell's law. But the level of reflection of the magneto-ionic component is the level where the wave-packet *as a whole* is travelling horizontally and is given by the condition that the root of the quartic equation for q corresponding to the upgoing magneto-ionic component should be equal to a root corresponding to a downcoming magneto-ionic component. The detailed application of these results to the ionosphere depends on our ability to solve the fundamental quartic equation for q, and the only practical way of achieving this in general is to resort to one of the standard numerical methods. Special cases worked out in this way show that the critical electron density required for reflection of a magneto-ionic component can easily be as much as 25% in excess of the erroneous value which would be calculated by putting the angle of refraction equal to $\frac{1}{2}\pi$ in Snell's law. The analytical solution of the quartic equation for q is sufficiently simple to be of practical value in the case of east-west transmission (including vertical incidence) and in the case of propagation in equatorial regions. Owing to the symmetrical influence of the earth's magnetic field upon the propagation of the upgoing and downcoming waves in these special cases, it is legitimate to calculate the critical electron densities of the magneto-ionic components from the condition ($q = 0$) that the direction of phase propagation is horizontal. Representative curves are drawn. AUTHOR.

865. Stratification of Ionosphere and Origin of E_1 Layer. J. N. Bhar. *Indian Journ. Phys.* 12. *pp*. 363–386, *Nov*., 1938.—Calculations of upper atmospheric ionisation are made after Pannekoek with certain modifications. It is assumed that the upper atmosphere above 100 km. consists mainly of N_2 and O while the lower and the middle atmosphere below this level consists of N_2 and O_2. There is a layer of transition between the two occupying the region 80–130 km. The temperature in the upper atmosphere is assumed to be 600° K. and that in the transition layer 300° K. The sun is taken to be radiating like a black body at 6800° K. Calculations show that there are ionisation maxima at 250 km. due to O, at 160 km. due to N_2 and 90 km. due to O_2. These three maxima are identified with the F_2, F_1 and E_1-regions. The most interesting point to be noted is that attempts at obtaining from theoretical considerations a layer of ionisation at the height of the E_1 region have hitherto failed. This, in fact, prompted Chapman to put forward the hypothesis that the ionisation of the F region was due to ultra-violet radiation while that of the E region was due to the bombardment of neutral corpuscles shot off from the sun. It is well-known that observations during solar eclipses prove definitely that the E_1-region ionisation is also due to solar u.v. radiation. The work described here thus removes the anomaly regarding the formation of the E_1 layer. It can now be definitely asserted that the region round 100 km. in which rapid transition of O_2 to O occurs is also, as a consequence, the region of maximum ionisation of O_2 and that the ionised layer formed near this level is to be identified with the E_1 layer. AUTHOR.

866. Dispersion, Absorption and Polarisation Curves for Radio Wave Propagation in Ionosphere. S. P. Ghosh. *Indian Journ. Phys.* 12. *pp.* 341–354, *Nov.*, 1938.—Dispersion, absorption and polarisation curves for radio wave propagation in the ionosphere for frequencies 3·0, 1·27, 0·6 megacycles and for collisional frequencies 0·0, 10^6, 5·4 × 10^6, 10^7 are drawn on the basis of the magneto-ionic formulæ of Appleton and Hartree for the magnetic condition of the upper atmosphere at Calcutta (total intensity 0·452 gauss, dip 31°45′N). In connection with the state of polarisation of the downcoming waves the case of limiting polarisation is discussed. It is shown that contrary to the view held by some authors, the polarisation of the two split components on their emergence from the ionosphere will, in general, be elliptical. This latter view confirms the experimentally obtained results regarding the nature of limiting polarisation. AUTHOR.

867. Ionospheric Investigation of Lorentz Polarisation Correction. H. G. Booker and L. V. Berkner. *Terr. Mag.* 43. *pp.* 427–450, *Dec.*, 1938.—Some years ago considerable discussion took place concerning the relation between the constitution of the ionosphere and its refractive index for radio waves. The question at issue was whether the force per unit-charge exerted by the electric field of a radio wave upon an elementary charged particle in the ionosphere should be taken simply as the Maxwellian electric intensity E (the Sellmeyer theory), or whether there should be added a contribution $(4\pi/3)P$ (the Lorentz theory). The discussion culminated in a theoretical treatment of the subject by Darwin which seemed to point to the conclusion that the Sellmeyer theory should hold good in the ionosphere at radio frequencies. For reflection from the ionosphere of radio waves of frequency less than the gyromagnetic frequency there is in middle latitudes a clear-cut distinction in the behaviour of the extraordinary wave according to the two theories. Over the past year a large number of records showing magneto-ionic splitting of ionospheric echoes at these wave frequencies have been obtained. The authors are led to believe that it is impossible to interpret these observations in terms of the Sellmeyer theory but that no objection exists to their interpretation in terms of the Lorentz theory. On the basis of the Lorentz theory the observations indicate that there is in the E region of the ionosphere a level of maximum atomic and molecular ion-density somewhat below the level of maximum electron-density. AUTHORS.

868. Ionospheric Measurements at Central China College, Wuchang, China, Oct. 1937 to June 1938. P. L. Sung and C. T. Kwei. *Terr. Mag.* 43. *pp.* 453–461, *Dec.*, 1938.

869. Trends of Characteristics of Ionosphere for Half a Sunspot Cycle. N. Smith, T. R. Gilliland and S. S. Kirby. *Bureau of Standards, J. of Research*, 21. *pp.* 835–845, *Dec.*, 1938.—The increase of solar activity from the sunspot minimum of 1933 to 1938 resulted in large increases in the ionisation of the upper atmosphere. During this time the ionisation densities of the E layer increased by a ratio of approximately 1·55 to 1 and those of the F_2 layer by about 4 to 1. Superposed on this long-period increase were the more or less regular diurnal and seasonal variations. Graphs indicating the long-time variations for the different layers at several different times of day are shown. AUTHORS.

***870. Time Marker for Moving-Coil Oscillographs. L. W. Sontag and E. Huff.** *Science*, 88. *pp.* 459–460, *Nov.* 11, 1938.—The time marker described was designed to be of a very simple construction and to produce time lines crossing the full width of the photographic paper. It consists of a slotted brass cylinder mounted on bearings within a slightly larger fixed cylinder. The outer cylinder with axis horizontal has two opposing slots cut parallel to the axis on the upper and lower sides. The inner cylinder has from 2 to 40 opposing slots which, as they revolve, pass the pair of slots in the outer cylinder. A line source of light mounted in line with the two slots of the outer cylinder, is eclipsed at the desired frequency as the inner cylinder revolves. An optical arrangement is described illustrating the method of mounting the time marker on a Westinghouse moving-coil oscillograph. A. B. W.

871. Wide-Range Beat-Frequency Oscillator. A. C. Hall. *Rev. Sci. Instruments*, 10. *pp.* 38–40, *Jan.*, 1939.—A beat-frequency oscillator is described which has a frequency range from 5 to 1600 kc./sec., and a maximum power output of 10 W. Broad-band amplifier principles are utilised in the design to obtain an output voltage substantially independent of frequency throughout the range of the oscillator. AUTHOR.

See also Abstracts 570, 776 and

383B. Long-Period Records of Ionosphere. W. Dieminger and H. Plendl.
384B. Bending of Electromagnetic Waves beyond the Horizon. R. M. Wundt.

PHOTOELECTRICITY.

872. External Photoelectric Effect of Semiconductors. E. U. Condon. *Phys. Rev.* 54. *pp.* 1089–1091, *Dec.* 15, 1938.—An analysis of the effect of contact potentials on photoelectric measurements with semiconductors is made, which indicates a new method of determining the width of the forbidden energy interval for electrons in a semiconductor. A possible application to precision determination of h/e by the photoelectric effect is indicated. AUTHOR.

873. Photoelectric Properties of Atomic Layers of Cs and K on W and Pt. H. Mayer. *Ann. d. Physik*, 33. 5. *pp.* 419–444, *Nov.*, 1938.—Continuing previous work [see Abstract 3289 (1937)] the author evaporates measured numbers of Cs and K atoms on to W and Pt and measures the photoelectric effect per unit of incident energy for layers up to 100 atoms thick and for monochromatic illumination of wave-length from 800 to 2400 Å. It is found that in all cases the photoelectric effect passes through a maximum at the same layer thickness as does the thermionic emission. The work function is determined as a function of layer thickness. A weak selective photoelectric effect, for which the electrons are derived from the carrier metal, appears with less alkali metal deposit than that which gives the photoelectric maximum. After this maximum is passed a second selective effect (the one usually observed) appears; in this the electrons are derived from the alkali metal atoms. L. A. W.

874. U.V. Sensitivity of Composite Alkali-Metal Photo-Kathodes. W. Kluge. *Zeits. f. techn. Physik,* 19. 12. *pp.* 597–600, 1938.—It is found that for wave-lengths below about 300 $m\mu$ the spectral sensitivity curve of kathodes of the type designated Ag-M_2O-M (where M is successively Cs, Rb, K) is not smooth, but exhibits a band-like structure, characteristic for each kathode. It is argued that this band-like structure represents the spectral absorption of the oxide layer, of which the lattice is distorted through the inclusion of alkali-metal and silver atoms. D. H. F.

875. Mechanism of Emission from Composite Photo-Kathodes. H. Teichmann. *Zeits. f. techn. Physik,* 19. 12. *pp.* 600–602, 1938.—Measurements were made of the spectral sensitivity of the photo-emission from composite kathodes of the forms designated Cs-Cs_2O-Ag and K-(K_2O)Al_2O_3-Al, and of the spectral sensitivity in the same kathodes of the barrier-layer photo-effects at the boundaries of the intermediate semi-conductor with the alkali-metal surface and with the base metal. The forms of the curves obtained lend support to the hypothesis that the semi-conducting properties of the intermediate layer play an important part in determining the photo-emissive sensitivity of kathodes of this type. D. H. F.

876. Surface and Volume Photoelectric Emission from Barium. R. J. Cashman and E. Bassoe. *Phys. Rev.* 55. *pp.* 63–69, *Jan.* 1, 1939.—Spectral sensitivity measurements between 5000 and 2300 Å have been made on Ba surfaces prepared by fractional distillation in a gettered vacuum. The resulting yields are compared with those predicted by Mitchell's square-top barrier theory [see Abstract **2438** (1936)] which is here modified to a form that facilitates comparison with experimental data. From 5000 to 3000 Å relative values of the observed yields are in good agreement with the modified theory. At 2967 Å there is an abrupt rise in the experimental curve which continues to the limit of the measurements. This is attributed to the onset of the volume photoelectric effect. The theoretical threshold for the volume effect calculated from the rough formulæ of Tamm and Schubin agrees well with the experimental value. AUTHORS.

877. Origin of Multiple Spectral Maxima at Complex Photo-Kathodes. R. Suhrmann and A. Mittmann. *Zeits. f. Physik,* 111. 1–2. *pp.* 18–35, 1938.—Spectral sensitivity curves have been obtained at 293° and 83° K. for 12 photo-kathodic complexes. Those of the type alkali metal—*X*—alkali metal exhibit a long-wave maximum. The position of the maximum is characteristic of the alkali metal, and is displaced to shorter wave-lengths on cooling. With naphthalene as *X*, a second maximum is observed at short wave-lengths; its position is independent of the alkali metal and of temperature and is characteristic of *X*. This maximum is exhibited also by complexes of the type alkali metal—naphthalene. With anthracene as *X*, these maxima are replaced by several minima. W. R. A.

See also Abstracts 560, 648, 793, 804.

PIEZOELECTRICITY.

878. N.P.L. Notation for Piezoelectric Quartz. I. Koga. *E.T.J.* 2. *pp.* 287–289, *Dec.*, 1938. *In English.*—It is suggested that the method of denoting the trigonal axis of symmetry of quartz given in the N.P.L. pamphlet entitled *Notation for Piezoelectric Quartz* should be altered so that right- and left-handed crystals do not require separate mathematical consideration. It is also suggested that the recommended notation for the orientation of the cutting plane should be reversed. J. T.

879. Effect of Radiations on Pyroelectric Crystals. Yeou Ta. *Comptes Rendus*, 207. *pp.* 1042–1044, *Nov.* 28, 1938.—The absorbed portion of radiation falling on the surface of a pyroelectric crystal being converted to heat polarises it, and if the opposite surfaces be coated with a metallic deposit and connected through a galvanometer a measurable current is produced indicating production of a quantity of electricity Q, which is proportional to the change in temperature Θ, and the area of crystal S on which the radiation falls, *i.e.*, $Q = K\Theta S$, where K is a constant. This effect has been confirmed by experiments with tourmaline, which show that it is the infra-red portion of any radiation that is mainly responsible for the effect. Preliminary experiments with tartaric acid show it to be some four times as sensitive as tourmaline. C. A. S.

THERMIONICS.

880. Surface Migration of Barium. M. Benjamin and R. O. Jenkins. *Phil. Mag.* 26. *pp.* 1049–1062, *Dec.*, 1938.—It is found that under similar vacuum conditions Ba does not migrate over W, although Th does. It is also shown that Ba does not migrate over Ni. AUTHORS.

881. Thermionic Emission and Content of Free Alkaline-Earth Metal in the Oxide-Coated Filament. C. H. Prescott, Jr., and J. Morrison. *Am. Chem. Soc., J.* 60. *pp.* 3047–3053, *Dec.*, 1938.—Using a filament coated with a colloidal mixture of BaO, SrO, finely divided Ni, and free alkaline-earth metal, the authors have investigated the quantitative relation between thermionic emission and the content of active metal. A high level of activity was found from 15 μgm./cm^2. to 60 μgm./cm^2. to equivalent Ba, with a slight apparent maximum at 30 μgm./cm^2. where the thermionic current at 1050° K. is 600 mA/cm^2. The electron work function is 1·37 V. The radiant emissive power at 0·66 μ is approximately 64%, independent of the content of active metal. The free alkaline-earth metal was determined by oxidation with CO_2 and analysis of the gaseous reaction products. AUTHORS.

See also Abstract 873.

THERMOELECTRICITY.

See Abstract 801.